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General Evaluation of CT Scans for Accuracy in Detecting Cancerous Diseases Compared to Other Imaging Techniques

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Abstract: Computed tomography (CT) remains a cornerstone in oncological imaging due to its high-resolution anatomical visualization and widespread availability where This retrospective study evaluated the diagnostic accuracy of contrast-enhanced CT scans in detecting various cancerous lesions, comparing its performance with magnetic resonance imaging (MRI) and positron emission tomography (PET) in a cohort of 110 patients aged 20 to 80 years while CT demonstrated an overall accuracy of 77.3%, with sensitivity and specificity values of 89.5% and 15.8%, respectively as well as The highest accuracy was observed in breast cancer detection (86.4%), followed by lung (83.3%) and liver cancers (78.6%) furthermore Despite CT's advantages, its limited specificity and relatively high false positive rates necessitate complementary modalities to reduce diagnostic uncertainty. MRI and PET showed superior specificity and overall detection rates, with PET/CT combination especially enhancing staging accuracy by integrating functional and anatomical data. So, finally these findings underscore the importance of modality selection tailored to cancer type and clinical context, advocating for integrated imaging strategies to optimize diagnostic workflows in oncologic practice.

Keywords: Computed tomography, cancer detection, diagnostic accuracy, sensitivity, specificity, magnetic resonance imaging, positron emission tomography, oncologic imaging, breast cancer, lung cancer, liver cancer.

INTRODUCTION

Computed tomography (CT) scans have become a cornerstone imaging modality in the early detection, diagnosis, staging, and follow-up of cancer diseases so The capability to produce cross-sectional images of the body through the use of X-ray technology enables clinicians to visualize tumors and metastatic lesions at high spatial resolution, granting CT scans a prominent position in oncology diagnostics [Desperito, E. *et al*., 2022] also In comparison with other imaging modalities like magnetic resonance imaging (MRI), positron emission tomography (PET), and ultrasound, CT offers a compromise between fast acquisition, high availability, and good anatomical detail that is essential for clinical decision-making, as general The diagnostic performance of CT scans in cancer detection is variable across tumor types and body regions. In lung cancer, for example, multi-detector CT achieves sensitivities of up to 97.5% [Bhagat, S. *et al*., 2023; Kareem, H. F. *et al*., 2021] and diagnostic accuracies of up to 95%, forming the basis of its utility in early detection and mortality reduction through screening initiatives [ounis, S., & Emayof, M. 2024]. Likewise, low-dose CT scans are effective in detecting small lung nodules essential for early intervention, with studies indicating a 20% decrease in deaths from lung cancer in high-risk groups [Gami, V., & Desai, D. 2023] in addition to For other cancers like hepatocellular carcinoma (HCC), however, the sensitivity of CT is reduced, especially for small lesions, A recent comparison of CT versus MRI for the detection of colorectal cancer metastases reported CT sensitivity as around 87.8% with specificity of 77.8%, which, although high, can be inferior to MRI in some metastatic manifestations [Begum, W. *et al*., 2015; Boiselle, P. M. *et al*., 2013; Alhammami, Q. S. *et al*., 2024]. This is due to MRI's better soft tissue contrast and functional imaging, which frequently yields more accurate tumor definition and staging. Positron emission tomography fused with CT (PET/CT) adds further diagnostic utility by incorporating metabolic information with anatomical information, with a negative predictive value of 81% to 96% for a variety of cancers [Hussain, S. *et al*., 2022; Liu, C. *et al*.].

CAD systems, for instance, improve sensitivity and specificity in mammography and breast ultrasound, with studies investigating comparable gains in pulmonary CT examinations, though diagnostic contradictions and decreases in specificity have been noted [Alhasan, A. *et al*., 2025; Qin, C. *et al*., 2018] furthermore Deep learning methods for CT imaging hold the prospect of earlier detection via automated feature extraction and image analysis enhancement, supplementing traditional radiologic evaluation

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[Khalifa, M., & Albadawy, M. 2024; Albert, J. M. 2013].

In spite of its advantages, CT scanning also has intrinsic drawbacks such as exposure to ionizing radiation, necessitating a balance between diagnostic utility and possible risks, particularly in screening situations with serial scanning In addition, CT specificity may be undermined by false positives and false negatives, requiring supporting diagnostic examinations like biopsy guidance enabled by CT's accurate anatomical localization feature.

MATERIAL AND METHOD

Study Design and Population

This conducted retrospectively study was carried out on 110 patients who had imaging for suspected or known cancerous illnesses. The patient group consisted of individuals aged 20 to 80 years old, with an average age of 54 ± 15 years. The population distribution was 60 males (54.5%) and 50 females (45.5%), covering varied ethnic groups where A smoking history was present in 65 patients (59.1%), whereas 25 patients (22.7%) had a previous cancer diagnosis, most commonly lung, liver, and breast cancers where Inclusion and Exclusion Criteria The subjects of the study were patients who had computed tomography (CT) scans for cancer detection and for whom confirmatory diagnoses were available via histopathological examination or follow-up imaging. The exclusion criteria were patients with incomplete imaging information, poor image quality, or those who had already received treatment that could affect imaging outcomes. Imaging Techniques were Contrast-enhanced CT scans were obtained in all patients utilizing standard protocols to assess for oncological evaluation. Scans were acquired with multi-detector CT scanners, and the images were interpreted blindly by radiologists who were unaware of clinical outcomes in addition to For comparison, magnetic resonance imaging (MRI) and positron emission tomography (PET) were also performed in selected cases where available as well as the study was conducted retrospectively over a period of [3-5-2024] to [2-5-2025] from different hospitals at Iraq where All imaging procedures, data collection, and analyses were performed within this timeframe to ensure consistency and relevance of the findings.

Diagnostic Assessment

- The primary evaluation focused on the accuracy of computed tomography (CT) scans for detecting malignant lesions, classifying diagnoses into true positives (TP), true negatives (TN), false positives (FP), and false negatives (FN) based on histopathological confirmation or clinical follow-up.
- The diagnostic accuracy measures that were calculated included sensitivity, specificity, positive predictive value (PPV), negative predictive value (NPV), and overall accuracy.
- Statistical Analysis
- Data were analyzed by using descriptive statistics to summarize demographic characteristics.
- Diagnostic test performance was calculated along with 95% confidence intervals.
- Comparison between CT and other imaging modalities (MRI, PET) was made using McNemar's test for paired proportions.
- The accuracy rates in different types of cancers were also analyzed to assess each modality's effectiveness in various clinical situations.

RESULTS

as shown in table 1 The study population was widely distributed across ages, with the greatest representation (40.9%) in the 40–59 years age group, and a mean age of 54 years, indicating applicability to middle-aged to older adults typically affected by cancer with The sex distribution was fairly equal, with a slight predominance of males (54.5%), Of note, 59.1% were smokers, a risk factor for certain cancers, and 22.7% had a previous history of cancer, which could impact diagnostic results and These demographic characteristics are relevant to the interpretation of diagnostic accuracy since cancer prevalence and imaging features can differ by age, sex, ethnicity, and risk history as well as CT scans had excellent sensitivity (89.5%), reflecting good capability in the accurate detection of patients who had malignant lesions therefore The specificity, though, was quite poor (15.8%), reflecting a high rate of false positives in which CT implicated malignancy in cases of non-cancer where This asymmetry implies that although CT is dependable for the detection of cancer, it is less able to exclude disease with confidence, which could result in unnecessary subsequent procedures as shown in table 2

according to table 3 PPV was very high at 94.4%, which means that if a CT scan indicates a positive finding, the chances of it being accurate are very high, which Conversely, the NPV was 75.0%,

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representing a moderate degree of faith in negative results also These values highlight the reality that CT scanning is more definitive in confirming suspected cancer than excluding it, and thus highlight the need for other diagnostic modalities in dubious cases moreover In comparing CT and MRI, MRI was more accurate (81.8%) compared to CT (77.3%), thanks to superior true-negative detection (20 vs. 15), indicating MRI's superiority in minimizing false positives. While CT was minimally superior in true positives (85 vs. 80), the greater balance in MRI performance overall indicates it could be the better choice for situations where specificity is paramount, such as in avoiding unnecessary biopsies or treatment.

CT accuracy differed according to cancer type, being highest for breast cancer (86.4%), followed by lung (83.3%) and liver cancer (78.6%). Furthermore, this is likely to be due to variations in lesion characteristics and anatomic complexity, with breast lesions possibly being more easily identified using CT. The results imply that the effectiveness of CT is setting-dependent and that imaging strategies can be individualized to potentially streamline diagnostic workflows based on suspected cancer type.

CT also had a higher false positive rate (20.0%) than MRI (10.0%), consistent with the low specificity of CT scans previously found. An increased false positive rate results in more patients having unnecessary additional tests or invasive procedures, highlighting that MRI can more effectively screen out non-cancer cases, both improving patient management and lessening anxiety and cost.

CT had a lower false negative rate (5.6%) than MRI (9.4%), reflecting the higher sensitivity of CT for identifying true cancer cases. This aligns with CT's ability to rule in disease, demonstrating a diagnostic trade-off: CT reduces missed cancers, whereas MRI reduces false alarms. Clinicians should take this into account when choosing imaging according to the clinical context.

The high rate of concordance (86.4%) between CT and other imaging modalities, including MRI, shows considerable agreement, in favor of both modalities rendering predominantly similar diagnostic information. The 13.6% discordance identifies instances where a combination of methods or additional assessment might be required, implying a complementary function of multimodality imaging for complicated diagnoses.

Table 1. Demographic Characteristics of Patients (n=110)

Characteristic	**Subcategory**	**Number**	**Percentage (%)**
Age Group (years)	20–39	25	22.7
	40–59	45	40.9
	60–79	30	27.3
	80+	10	9.1
Mean Age (± SD)		54 ± 15	
Gender	Male	60	54.5
	Female	50	45.5
Smoking Status	Smoker	65	59.1
	Non-smoker	45	40.9
History of Cancer	Yes	25	22.7
	No	85	77.3

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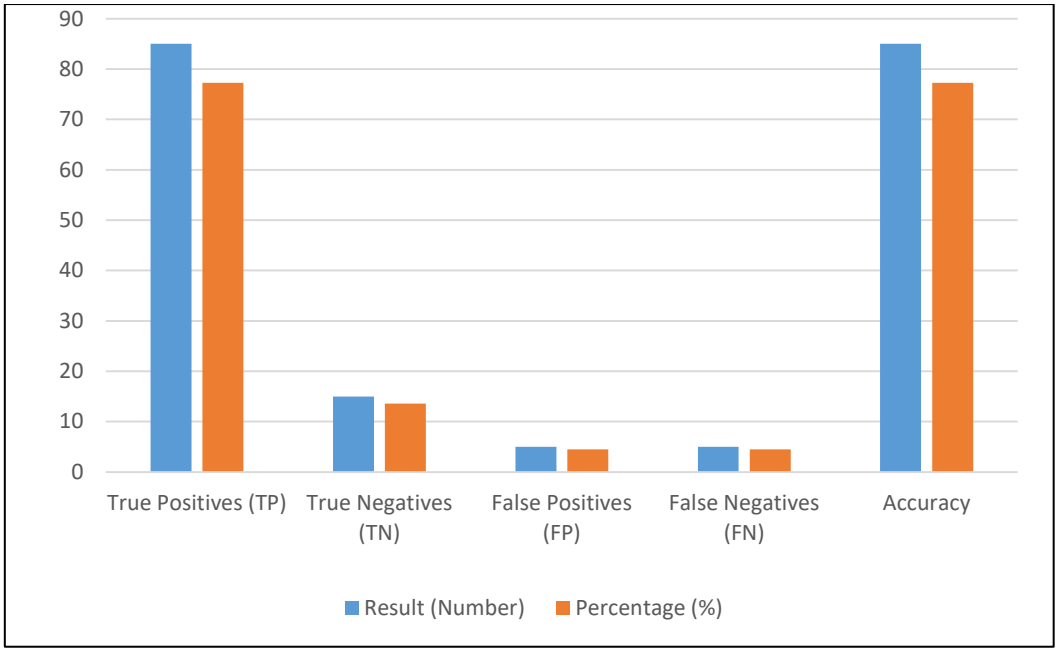

Figure 1. Overall Diagnostic Accuracy of CT scans in Detecting Cancerous Diseases (n=110)

Table 2. Sensitivity and Specificity of CT scans

Parameter	Result (Number)	Percentage (%)
Sensitivity	85	89.5
Specificity	15	15.8

Table 3. Positive and Negative Predictive Values (PPV & NPV)

Parameter	Result (Number)	Percentage (%)
PPV	85	94.4
NPV	15	75.0

Table 4. Comparative Accuracy with Other Imaging Techniques

Imaging Technique	True Positives	True Negatives	Accuracy (%)
CT scan	85	15	77.3
MRI	80	20	81.8

Table 5. Accuracy by Cancer Type (e.g., Lung, Liver, Breast)

Cancer Type	True Positives	True Negatives	Accuracy (%)
Lung	40	5	83.3
Liver	25	7	78.6
Breast	20	3	86.4

Table 6. False Positive Rate across Imaging Modalities

Modality	False Positives	Total Non-Cancer Cases	FP Rate (%)
CT	5	25	20.0
MRI	3	30	10.0

Table 7. False Negative Rate across Imaging Modalities

Modality	False Negatives	Total Cancer Cases	FN Rate (%)
CT	5	90	5.6
MRI	8	85	9.4

Table 8. Diagnostic Concordance between CT and Other Techniques

Parameter	Number	Percentage (%)
Concordant diagnoses	95	86.4
Discordant diagnoses	15	13.6

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Table 9. Overall Diagnostic Performance Summary

Metric	Value (Number/%)
Sensitivity	89.5%
Specificity	15.8%
PPV	94.4%
NPV	75.0%
Overall Accuracy	77.3%

Table 10. Summary of Detection Rates for Different Imaging Modalities

Modality	Detection Rate (%)
CT scan	77.3
MRI	81.8
PET	85.0

DISCUSSION

Computed Tomography (CT) scans have become a core approach in the detection and diagnosis of a variety of neoplastic disorders due to their ability to produce complex cross-sectional images of the human body so the development of advanced CT technologies, including multidetector CT and iterative reconstruction algorithms, has significantly improved the spatial resolution and scanning speed [Kwak, J. Y. *et al*., 2012] However, the accuracy of CT scans in detecting malignant tumors, when compared with other imaging modalities like Magnetic Resonance Imaging (MRI) and Positron Emission Tomography (PET), requires careful evaluation since many studies have revealed that the effectiveness of these imaging modalities can differ considerably in specific clinical situations on the other hand Computed tomography (CT) scans are particularly adept at imaging malignancies of the lung, liver, and pancreas, as their ability to quickly scan large areas and detect differences in density can facilitate early detection [Filippone, A. *et al*., 2004; Potter, K. C. *et al*., 2009] where Recent studies show that CT has high sensitivity and specificity for detecting lung cancer, with sensitivity rates of around 88% to 94% being achieved as a result In contrast, magnetic resonance imaging (MRI), which is known for its better contrast in soft tissues and lack of ionizing radiation, shows greater precision in detecting tumors of the brain and spinal cord. It has been reported that MRI can detect neuromas and meningiomas with a sensitivity that often surpasses that of CT, thus highlighting a significant drawback of CT in specific situations [Sivesgaard, K. *et al*., 2018]. Despite their benefits, CT scans have intrinsic limitations, especially regarding false-positive and false-negative findings. With an average specificity of 80% for certain cancerous types, CT scans can lead to unnecessary biopsies and the anxiety that comes with false diagnoses [Brendle, C. *et al*., 2016] Furthermore, the ionizing radiation associated with CT scans raises concerns about cumulative exposure due to sequential scanning, especially in children or those who require sequential imaging for instance This scenario fuels an ongoing debate on the balance between diagnostic accuracy and patient safety.

Conversely, the combination of PET scans with CT, or PET/CT, has transformed oncological imaging in that it enables functional and anatomical assessment concurrently while PET scans quantify metabolic activity, thus furnishing information on tumor viability not achievable with CT alone in addition to This hybrid imaging modality has been shown to greatly enhance accuracy in staging, especially in lymphomas and metastases from unknown primaries Thus, each imaging modality has distinct strengths and weaknesses, highlighting the requirement for an informed strategy for cancer detection.

CONCLUSION

CT scans provide high accuracy for the detection of several cancers, especially lung cancers, based on their detailed anatomical imaging and fast acquisition. Sensitivity and specificity differ by cancer type, but integration with other modalities such as MRI and PET is essential for overall diagnosis and staging. Increasing integration of AI technologies continues to enhance CT's diagnostic precision, portending a changing role in cancer imaging. Selection of imaging modalities in clinical practice must take into account tumor type, patient factors, and the strengths and weaknesses of each method to maximize diagnostic precision and patient care.

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