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Original article

Role CT imaging for Cancer Diagnosis by Determining Sensitivity and Specificity: 144 Cancer Cases in Tobruk, Libya

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ABSTRACT

Computed tomography (CT) has emerged as a highly accurate and the most effective technique for detecting and diagnosing various types of cancer. It also aids in evaluating the cancer's stage, size, and form. CT has become the mainstay for cancer detection in Libya, where cost and accessibility are the primary factors determining the modality for diagnostic purposes. The study aims to evaluate the role of CT by correlating the CT scan results with histological findings and determining its sensitivity and specificity in diagnosing various cancers. The study was conducted on 144 patients who underwent CT scans between January 2023 and March 2024. The age range of 31–40 years had the highest percentage of cases, with 39 (27.08%). A CT scan showed 98.52% sensitivity and 87.50% specificity, demonstrating high accuracy in identifying malignant and benign cases. The precision and accuracy of CT scans were 99.25% and 97.91%, respectively. This study demonstrates that CT is highly sensitive in detecting cancers, making diagnoses, and particularly in identifying its morphology and type, estimating whether it is benign or malignant, and identifying any other associated findings with high sensitivity and specificity.

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INTRODUCTION

Cancer is an important cause of mortality and mortality on a global scale, and its prevalence is growing in developing countries. According to WHO, roughly 20 million new cancer cases and 9.7 million deaths were recorded in 2022. The estimated number of those who survived during 5 years after being diagnosed with cancer was 53.5 million. Approximately 20% of individuals will be diagnosed with cancer at some point in their lives, with approximately 11% of men and 8% of women surviving the disease [1]. Therefore, it is crucial to devote greater attention to comprehending the importance of diagnostic and treatment strategies. Regarding this matter, the most suitable option for diagnosing cancer is the radiological investigation approach, particularly a CT scan.

CT is a non-invasive medical imaging approach that uses advanced X-ray technology to provide exact images of internal body regions. When it comes to dealing with cancer patients, computed tomography has been regarded as an essential technique by both radiologists and oncologists. Regardless of the stage of the tumour or whether or not it is thought to be present in patients, this method is frequently utilized for a wide range of medical conditions. Every year, it is carried out 375 million computed tomography (CT) procedures all over the world, with an annual increase of between 3% and 4% [2].

CT scans create high-quality images that assist in the detection and diagnosis of cancers, determination of cancer location and size, and evaluation of cancer stage. In addition, they have the capability to ascertain the presence or absence of blood vessels in the region. CT scans allow healthcare professionals to evaluate treatment progression and patients' medical state after treatment. Furthermore, a CT scan may demonstrate the morphology of a tumour along with its possible constituents, such as solids or liquids. There is a potential correlation between this information and the presence of cancer. However, it cannot currently independently detect cancer. To determine the malignancy of the microscope after performing a biopsy [3]. However, CT scans have a discernible influence on medical decisions in 14-30% of patients. This matter requires more evaluation and is particularly relevant when considering the appropriate use of costly technologies [4].

The CT scan's role in cancer detection has already been the subject of numerous studies [4-9], Gupta et al. discovered that multidetector CT scans are very good at finding focal hepatic lesions, with a sensitivity of 80-100% and a specificity of 96.4-100%. That means they are a very effective, noninvasive way to find and describe hepatic lesions [7].

The study by Sadako Akashi-Tanaka et al demonstrated a sensitivity of 79-90% and a specificity of 70-89%. Additionally, they successfully identified occult breast cancer with axillary metastases and diagnosed local recurrence following breast-conserving therapy (BCT) [8]. Hussain et al. discovered incidental masses in 33 out of 432 individuals. Only eight individuals had received a diagnosis of primary cancer. Furthermore, there is a lack of data indicating the existence of breast masses and no reference to any instances of false negative assessments in the patients [9]. CT has become the mainstay for cancer detection in Libya, where cost and accessibility are the primary factors determining the modality for diagnostic purposes. This study evaluates the role of CT in the detection of cancers and determines its sensitivity and specificity in diagnosing various types of cancer.

METHODS

Data was obtained from the computer records at the Departments of Radiology in Alafia Clinic between January 2023 and March 2024, which included demographic characteristics such as age, sex, and diagnosis date.

All CT scans in Alafia Clinic were performed using a Siemens Somatom Sensation Cardiac 64 slice scanner with 0.5 s gantry rotation speed and a tube voltage of 120 KV. The tube current was determined using an automated current modulator. Scans were performed using collimation with a slice thickness of 5 mm, pitch of 1.15 and image reconstruction of 1 mm. For contrast-enhanced scans, 100 ml of Omnipaque 300 contrast was injected intravenously at a flow rate of 3 ml/s.

The CT scans were systematically analyzed for cancer location, size, number, and morphology including density, calcification, necrosis, contrast enhancement, and other associated findings.

The confirmed case diagnoses were based on histopathological reports performed by Tobruk Medical Centre's Department of Histopathology between January 2023 and March 2024. This department received all of Tobruk City's cancer cases. Histopathological data confirmed whether the abnormalities were benign or malignant.

Sensitivity and specificity were calculated by formulae Gogtay, N. J., & Thatte, U. M., where the detection method sensitivity was calculated as the ratio of true-positive readings among true-positive and false-negative readings. Specificity was calculated as the ratio of true-negative readings among true-negative and false-positive readings [10].

The study design was approved by the Ethical Committee for Scientific Research at Tobruk University and is committed to the ethical guidelines of the 1975 Declaration of Helsinki. Written informed consent was not obtained from patients since this study was retrospective.

RESULTS

This study was conducted on 144 cases from radiology department whose diagnoses with different cancer types from January 2023 to March 2024 were verified using CT scans and histopathology. Due to the study's limited scope, it is not feasible to adequately investigate the function of CT in the initial detection of cancer across all anatomical locations. However, it is critical to take into account the most important general points.

The age group between 31 and 40 years had the highest percentage of cases, with 39 cases representing (27.08%). Among males, there were 65 cases (45.2%) affected by cancer, while among females, there were 79 cases (54.8%) affected. This resulted in a male-to-female ratio of 1.0:1.2, as shown in table 1.

The study categorizes the cancer cases based on the primary cancer site. According to CT imaging findings, the cancer affecting the lung accounted for the highest percentage of cases, specifically 30 cases (20.9%). The study revealed 22 cases (15.3%) of bone cancer, 20 cases (13.9%) of brain cancer, 19 cases (13.2%) of liver and bile duct cancer, 16 cases (11.11%) of pancreatic cancer, 10 cases (6.9%) of renal cancer, and 6 cases (6.25%) of bladder cancer, while there were 4 cases (2.8%) of paranasal sinuses cancer, nasopharyngeal cancer, and salivary gland cancer having an equal number

of cancers. The study found that ovarian and adrenal cancer accounted for 3 (2.1%) cases each, while colorectal cancer accounted for 2 cases (1.4%) and one incidental case of breast cancer (Table 2).

Table 1: Demographic characteristics of cases (number of cases: 144)

Demographics	Number of cases	Percentage
Gender		
Male	65	45.2%
Female	79	54.8%
Total	144	100%
Age group		
>20	9	6.25%
21-30	31	21.52%
31-40	39	27.08%
41-50	27	18.76%
51-60	21	14.58%
<60	17	11.81%
Total	144	100%

Table 2. Classification of cases according to cancer site

Primary cancer	Number	Percentage
Lung cancer	30	20.9%
Bone cancer	22	15.2%
Brain cancer	20	13.9%
Liver and Bile Duct Cancer	19	13.2%
Pancreatic cancer	16	11.1%
Renal cancer	10	6.9%
Bladder cancer	6	4.2%
Paranasal sinuses cancer	4	2.8%
nasopharyngeal cancer	4	2.8%
salivary gland cancer	4	2.8%
Ovarian cancer	3	2.1%
Adrenal cancer	3	2.1%
colorectal cancer	2	1.4%
Breast cancer*	1	0.7%
Total	41	100%

**Incidental findings / 1 breast cancer case*

With the increase in CT imaging due to various reasons, it is not uncommon to discover cancer that was incidentally diagnosed. "Incidentally diagnosed cancer" refers to the detection of cancer in a case where the patient does not exhibit any known cancer symptoms and is not undergoing routine cancer screening [11]. The study determined the diagnostic status of cancer cases based on the recorded findings of one incidental case of breast cancer that appeared in a patient with a lung tumor. The study evaluated the appearance of the diagnostic cases on CT as part of the study's parameters. Most cases (84.3%) showed a heterogeneous solid appearance, while 15.7% showed a homogeneous appearance (Figure 1).

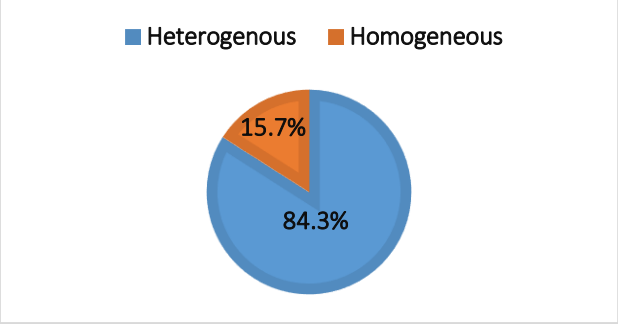

Figure 1. Cancer appearance on CT

CT scan results confirmed that 6.25% of the diagnosed cases had benign features, whereas 93.75% exhibited malignant features. When comparing the CT scan and histopathology results, correctly identified 93.05% of the cases as malignant (true positives), correctly identified 4.87% as benign (true negatives), incorrectly identified 0.69% as malignant (false positives), and incorrectly identified 1.38% as benign (false negatives). The CT scan technique had a sensitivity of 98.52%, and the specificity was 87.50%, indicating a high probability of accurately detecting malignant and benign cases. Furthermore, the precision on CT scans and histopathology was 99.25%, with an accuracy of 97.91%.

Table 3. The degree of conformity between CT scan findings and histopathology findings (N = 144).

CT scan findings	Histology		Total
	Malignant case	Benign case	
Malignant	134 (93.05%)	1(0.75%)	135 (93.75%)
Benign	2 (22.22)	7(77.78)	9 (6.25%)

Table 4. Correlating CT Scan Findings and Histopathology

CT scan findings	Histopathology		Total
	Positive	Negative	
Positive	134 True-positive	1 False-positive	135
Negative	2 Fase-negative	7 true-negative	9

Table 5: Sensitivity and specificity of CT scans to detect and diagnose cancer cases:

Parameter	Values
Sensitivity*	98.52%
Specificity*	87.50%
Accuracy*	97.91%
Precision*	99.25%

**Sensitivity = true positives/(true positives + false negatives). *Specificity = true negatives/(true negatives + false positives). *Accuracy = true positive + true negative/(true positive + false positive+ true negative+ false negative)*
**Precision = true positive/(true positive+ false positive).*

DISCUSSION

In recent years, CT scans have emerged as the most effective technique for detecting various types of cancer. They are essential in cancer diagnosis due to their high effectiveness in detecting tumors at an early stage in the body. CT scans are capable of detecting tumours before any symptoms appear. This applies to both individuals who undergo regular screenings and those who already experience symptoms; effective identification is crucial for maximizing the chances of successful therapy and recovery. CT scans are highly valuable for detecting tumors and providing crucial information about their characteristics. Additionally, CT gives radiologists and oncologists the knowledge and expertise to distinguish between benign and malignant features of tumors by evaluating the density of the tissue. This information provides valuable guidance for treatment decisions. Furthermore, CT scans are capable of accurately localizing and measuring tumor size, allowing for precise evaluation of location of the lymph node and adjacent critical organs. Given its significance in assessing the viability of surgical removal and the necessity for supplementary treatments such as chemotherapy or radiation therapy, this data plays a pivotal role in the formulation of treatment plans. The study aimed to evaluate CT imaging as a critical diagnostic tool by correlating the CT scan results with histological findings and determining sensitivity and specificity for this purpose.

Based on clinical findings, this study observed that most diagnosed cases belonged to the age group of 31-40 years (n = 39, 27.08%), followed by age groups 21-30 years (n = 31, 21.52%). The present study observed only 9 teenage cases of age <20 years (6.25%). Also, we studied the gender-wise distribution of the study cases and observed that the majority of the cases presented with cancer were females (n = 79, 53.8%), followed by males (n = 65, 46.2%). The study shows a slight increase in the number of cancer cases among females compared to males. This result corroborates the findings of multiple international studies [12, 13], that have explained the causes of the increase, including inadequate knowledge about cancer causes and risk factors, the importance of screening, anxiety about early screenings, fear of screening results, and the high cost of screenings. Studying age groups is crucial for understanding the spreading of disease across various ages, which should guide future epidemiological studies aimed at identifying social, environmental, and other risk factors related to this disease.

The capacity of CT to detect incidental findings continues to increase." In our study. CT scan cases incidentally revealed cancer. This result is comparable to Eskandary et al.'s research, which studied 3,000 individuals and identified just 30 incidental abnormalities. The study has presented strong evidence regarding the number of cases and typical situations that result in incidental cancer detection. This highlights the need for more studies to determine the potential consequences of incidentally detected cancer [14].

Computed tomography (CT) generates multidimensional reconstructions, revealing the location, morphology, density, and enhancement characteristics of a tumor. Nonetheless, achieving an accurate diagnosis only through imaging can be challenging. This study demonstrates the precision of CT scans in distinguishing between benign and malignant tumor characteristics. The result corresponds with the findings of prior studies [15].

The present study found that the sensitivity and specificity were 98.52% and 87.50%, respectively. Furthermore, the precision between CT scan findings and histopathology was 99.25%, with an accuracy of 97.91%. The study established the sensitivity and specificity of CT scans as a reliable diagnostic technique for accurately detecting cancer [15, 16]. However, some "false-positive findings" raise serious questions regarding both the general state of health and the level of radiation exposure during CT scans. The performance of surgery for "false-positive findings" may result in increased morbidity and death in cases who have undergone screening without providing a significant decrease in disease-specific mortality. Although CT scan and histopathology complement each other in cancer diagnostics, histopathology remains the preferred method for cancer diagnosis.

CONCLUSION

Computed tomography (CT) has emerged as a highly accurate and the most effective technique for detecting and diagnosing various types of cancer. It also aids in evaluating the cancer's stage, size, and form. Furthermore, medical providers perform CT scans to assess the proximity of cancer to adjacent internal organs or structures, provide guidance in creating an appropriate and effective treatment plan, assess the effectiveness of treatment, and provide post-treatment follow-up. Understanding the performance capabilities of CT scanners is critical given their widespread availability in Libya, particularly in Tobruk, where the CT technique is the only method available. the present study aimed to evaluate the role of CT imaging in cancer diagnosis by determining its sensitivity and specificity and correlating its results with histological findings for this purpose. The study demonstrates that CT is highly sensitive in detecting cancers, making diagnoses, and particularly in identifying its morphology, estimating whether it is benign or malignant, and identifying any other associated findings with high sensitivity and specificity. The study's limitation lies in its small sample size, in addition, many types of cancers, such as prostate cancer, cervical cancer, and breast cancer, can be diagnosed using other techniques, such as ultrasound and mammograms, without the need for CT scans. There has been a significant increase in the number of cancer cases worldwide, for this the reason. this study highlighted the urgent need for programs to provide advanced techniques for cancer diagnosis and screening, award training to radiologists, oncologists, and radiographers, and improve the overall management of all cancer types. Furthermore, the study anticipates that its findings will help improve knowledge and research on cancer imaging in Libya.

Conflict of interest. Nil

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دور التصوير المقطعي المحوسب في تشخيص السرطان من خلال تحديد الحساسية والنوعية: 144 حالة سرطان في طبرق، ليبيا

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المستخلص

تعتبر فحوصات التصوير المقطعي المحوسب تقنيات عالية الدقة يتم إجراؤها للكشف عن السرطان وتشخيصه. وقد أصبح التصوير المقطعي المحوسب الدعامة الأساسية للكشف عن السرطان في ليبيا، حيث تعد التكلفة وإمكانية الوصول من العوامل الأساسية التي تحدد طريقة التشخيص. تهدف الدراسة إلى تقييم دور التصوير المقطعي المحوسب من خلال ربط نتائج التصوير المقطعي المحوسب بالنتائج النسيجية وتحديد حساسيته ونوعيته في تشخيص أنواع مختلفة من السرطان. أجريت الدراسة على 144 مريضًا خضعوا لفحوصات التصوير المقطعي المحوسب بين يناير 2023 ومارس 2024. وكان لدى الفئة العمرية 31-40 عامًا أعلى نسبة من الحالات، حيث بلغ عدد الحالات 39 حالة (27.08%). وأظهر فحص التصوير المقطعي المحوسب حساسية بنسبة 98.52% وخصوصية بنسبة 87.50%، مما يدل على دقة عالية في تحديد الحالات الخبيثة والحميدة. بلغت دقة وضبط الأشعة المقطعية 99.25% و97.91% على التوالي. وتوضح هذه الدراسة أن الأشعة المقطعية شديدة الحساسية في اكتشاف السرطانات وتشخيصها، وخاصة في تحديد شكلها ونوعها، وتقدير ما إذا كانت حميدة أم خبيثة، وتحديد أي نتائج أخرى مرتبطة بها بحساسية وخصوصية عالية.

الكلمات المفتاحية. الأشعة المقطعية، السرطان، التشخيص، الحساسية، الخصوصية.