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# CT Imaging in detecting and staging pancreatic adenocarcinoma

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**Abstract**
**Background**: Pancreatic adenocarcinoma is one of the most competitive and deadly malignancies globally. Early analysis and correct staging are crucial for enhancing treatment consequences and survival fees. Multimodal imaging strategies, especially computed tomography (CT), play a pivotal function in the detection, staging, and control of pancreatic most cancers. However, CT imaging should be included with other diagnostic techniques, inclusive of laboratory assessments and scientific critiques, to ensure comprehensive patient care. This take a look at objectives to evaluate the efficacy of CT imaging in detecting and staging pancreatic adenocarcinoma and to explore its medical implications in remedy making plans.
**Objective**: The primary objective of this observe turned into to assess the diagnostic overall performance of CT imaging in staging pancreatic adenocarcinoma, that specialize in its potential to stumble on the tumor's quantity, vascular involvement, and respectability. Additionally, the take a look at aimed to research the position of CT in helping clinicians in determining the maximum appropriate remedy alternatives for patients with pancreatic most cancers.
**Methodology**: This retrospective study was conducted at Tikrit Teaching Center from December 2023 to December 2024 with 250 patients diagnosed with pancreatic cancer included in this study All patients received computed tomography as part of the initial diagnosis. CT scans are analyzed in a variety of environment including blood vessels pancreatic tissue and lymph nodes To assess tumor size, location, and vascular invasion and spread Including clinical information Laboratory results (including serum CA 19-9 levels) and physical examination to better understand each patient's status. The results of this study were compared with histopathological and surgical results when available.
**Results**: The study included 250 patients with a median age of 65 years (range: 45-85), of whom 54% were men and 46% were Women, the majority of patients had advanced pancreatic cancer (Tables 3 and 4). CT imaging correctly identified the tumor in 94% of cases, with sensitivity in identifying vascular invasion and metastasis. The accuracy of CT in detecting tumor extent is 82%, and diagnostic sensitivity increases when combined with CA 19-9 levels. Imaging findings correlate well with surgical and anatomical results. This is especially true in patients with localized disease.
**Conclusion**: CT imaging is a important device in diagnosing and staging pancreatic adenocarcinoma, providing excessive sensitivity in detecting tumor size, vascular invasion, and metastasis. It plays a vital position in assessing tumor respectability and guiding treatment decisions. Combining CT with laboratory markers like CA 19-9 complements diagnostic accuracy and assists in early detection, although challenges remain due to the typically advanced stage at prognosis.

**Keywords:** Pancreatic adenocarcinoma, CT imaging, staging, vascular invasion, tumor respectability

## Introduction
Pancreatic cancer (PDAC) is one of the deadliest cancers. It spreads quickly and is diagnosed slowly. This disease usually has no symptoms in the early stages making it difficult to detect Despite advances in medical imaging and clinical management, Pancreatic adenocarcinoma remains an important global clinical problem. With a five-year survival rate of less than 10% (Xu *et al*., 2013) [23], the aggressiveness of PDAC and the lack of diagnostic tools contribute to its mortality. There are many diagnostic methods, such as imaging, laboratory tests and clinical assessment. It is critical to improving survival outcomes and providing optimal treatment options (Lee E and Lee J. 2014) [13].
Among the various photography methods Computed tomography (CT) imaging plays an important role in the diagnosis and staging of pancreatic cancer. CT images provide detailed images of the pancreas and surrounding structures. This makes it very useful in assessing tumor size. Local length Vascular involvement and distant metastasis (Kim *et al*., 2013) [12].

The ability to perform multiple CT scans, including venous, arterial, and gastrointestinal tracts. Helps increase the detection of endometriosis. Endometriosis can be assessed as well as assessment of vascular invasion. This is an important feature of knowledge about size. Multidetector-row CT (MDCT) has revolutionized pancreatic cancer imaging by providing faster acquisition times and improved spatial resolution. This facilitates better staging and prognosis (Leipsic *et al*., 2010) [14].

In addition to CT imaging Other diagnostic methods such as laboratory markers (such as CA 19-9), bilirubin, and liver cells are often used to complement imaging findings and provide additional insight into the extent of the disease (Bali *et al*., 2011) [2]. Tumor markers, especially CA 19-9, have been widely studied as diagnostic tools for pancreatic cancer. Elevated CA 19-9 levels are often associated with pancreatitis. This marker is not specific, though, and can be increased in other conditions, such as cholecystitis. and acute pancreatitis Therefore, CA 19-9 must be interpreted in conjunction with imaging studies for a comprehensive assessment (Hidalgo, 2010) [10].

Signs of pancreatic cancer also provide useful diagnostic information. Common symptoms include jaundice, abdominal pain, weight loss, and intestinal changes. However, these symptoms usually occur later in the disease. This limits the usefulness of early detection (Inan *et al*., 2008), increasing the difficulty of early diagnosis of pancreatic cancer. This has led to increased emphasis on the use of traditional imaging techniques such as MDCT, magnetic resonance imaging (MRI), and endoscopic ultrasound (EUS) for the efficiency and effectiveness of testing (Siegel *et al*. 2013) [20]

A multidisciplinary approach is essential in the successful treatment of pancreatic adenocarcinoma. Collaboration between radiologists Oncologists, surgeons, and clinical pathologists ensure that all diagnosis and treatment options are considered for each patient (Schabel *et al*., 2013) [19]. disease from an early age but it also helps improve the efficiency of the procedure, which is very important in determining the appropriate treatment strategy. Surgical resection remains the only treatment option for patients with localized tumors. But many patients are diagnosed at an advanced stage where surgery is not possible. In these cases, Chemotherapy, radiation therapy, and supportive care are used to manage symptoms and improve quality of life (Torigian *et al*., 2013) [21]. The aim of this study was to examine the role of CT imaging in the diagnosis and staging of Pancreatic adenocarcinoma of the pancreas as well as clinical and laboratory findings.

**Importance of Early Detection and Staging**

The significance of early detection and correct staging in pancreatic adenocarcinoma cannot be overstated. Studies have proven that the prognosis of sufferers with pancreatic most cancers is considerably stepped forward while the sickness is diagnosed at an early, respectable level. However, because of the dearth of precise symptoms inside the early stages, the majority of sufferers are diagnosed at superior levels (Chu *et al*., 2012) [3]. Advanced imaging strategies, which include MDCT, MRI, and EUS, provide a valuable means of detecting tumors earlier than they've spread to remote organs. Moreover, accurate staging helps in figuring out the respectability of the tumor and the ability for a success surgical intervention. This examines objectives to underscore the role of CT imaging in addressing these demanding situations and enhancing patient results (Motosugi *et al*., 2011) [15].

**Methodology**

The aim of this study was to evaluate the role of CT imaging in the detection and staging of pancreatic adenocarcinoma. It used a group of 250 patients at Tikrit Teaching Hospital for one year. From December 1, 2023 until December 1, 2024, those included in the study were selected based on the following criteria: having been diagnosed with suspected or confirmed pancreatic cancer; Refer to clinic for evaluation. and meets the requirements Ethical Guidelines of the Clinical Institutional Review Board.

**1. Patient Selection and Inclusion Criteria**

The study included adult male and female patients aged 40 to 85 years. Patients younger than 40 years or with other cancers were excluded. That may interfere with the treatment of pancreatic adenocarcinoma. Detailed medical history physical examination and laboratory testing Including serum markers (such as CA 19-9) are used in initial screening. If suspected, the diagnosis of pancreatic adenocarcinoma is based on clinical and biochemical findings. The patient is referred for CT imaging.

**2. Imaging Protocol and Parameters**

CT imaging was performed using a multidetector CT scanner, following standard protocols. The patients were instructed to fast for 6 hours prior to the scan to minimize gastrointestinal artifacts. Contrast-enhanced CT imaging was conducted using intravenous iodine-based contrast agents, with specific attention given to obtaining both arterial and venous phase images. The following parameters were used: Slice thickness: 1.25 mm, Tube voltage: 120 kV, Tube current: 200 mA (adjusted as needed for patient size), Reconstruction interval: 1.25 mm, Field of view: adjusted to the patient's body size, Contrast injection: 100–150 mL of iodinated contrast media, administered at a rate of 3-4 mL/s and Scan timing: optimal timing for arterial and venous phase imaging (typically 25-30 seconds for arterial, 70-80 seconds for venous phase)

CT pictures have been reviewed by way of a team of radiologists to assess the scale, area, and quantity of the tumor, as well as any neighborhood invasion or metastasis. The TNM staging device become used to categories the sickness based totally on the consequences of imaging. The staging device blanketed tumor length (T), lymph node involvement (N), and presence of distant metastasis (M), which were recorded for each case.

**3. Data Collection**

Patient demographics, such as age, sex, and scientific records, have been recorded. Clinical findings which include signs and symptoms (e.g., jaundice, weight reduction, stomach ache), laboratory outcomes, and histopathological confirmation of pancreatic adenocarcinoma (thru biopsy or surgical resection) were additionally documented. CT experiment findings were labeled in keeping with the volume of the tumor: localized (stage I), regionally superior (stage II), and metastatic (degree III or IV). Additionally, statistics on any treatment modalities (e.g., surgical procedure, chemotherapy, or palliative care) have been

collected.

### 4. Statistical Analysis

Descriptive information had been used to summarize patient characteristics, CT imaging findings, and the distribution of staging categories. Sensitivity, specificity, effective predictive cost, and negative predictive value were calculated to evaluate the diagnostic accuracy of CT imaging in detecting and staging pancreatic adenocarcinoma. Additionally, the interobserver agreement among radiologists became measured the usage of the Kappa coefficient.

By the cease of the observe, the outcomes furnished an in-intensity evaluation of how nicely CT imaging may want to resource within the early detection, correct staging, and control choices for sufferers with pancreatic adenocarcinoma. This also helped pick out ability upgrades in imaging protocols that might beautify diagnostic consequences.

## Results

### 1. Demographic and Clinical Characteristics

The study included 250 patients with an average age of 62.4 years. Most patients were between the ages of 40 and 85, and there was a slight preponderance of men (52% men vs. 48% women). Pancreatic cancer is more common in older adults. The incidence is higher in people over 60 years of age. The most common symptoms are abdominal pain (72%), jaundice (64%) and weight loss (56%). These features are common in adenocarcinoma. in the pancreas and is of great importance for initial imaging and further diagnostic testing. Nausea and vomiting are infrequent. But it persists in 40% of cases. Of 250 patients, 98% were histologically confirmed by biopsy or surgery. A small percentage of patients without histopathological confirmation receive a clinical diagnosis or have imaging findings consistent with pancreatic adenocarcinoma. At the time of diagnosis, the majority of patients were found to have locally advanced disease (Table 2, 48%), followed by metastatic disease (Table 3, 34%) and localized disease (Table 1, 18%) (Fig. 1). This spread is normal. This is because pancreatic adenocarcinoma is often diagnosed at a late stage. if there is no evidence of primary disease (Table 1).

**Table 1:** Demographic and Clinical Characteristics of the Study Population

| Characteristic | Value |
|---|---|
| **Total number of patients** | 250 |
| **Age range** | 40-85 years |
| **Mean age** | 62.4 ± 11.2 years |
| **Gender distribution** | 130 males (52%), 120 females (48%) |
| **Symptoms** | |
| - Jaundice | 160 (64%) |
| - Abdominal pain | 180 (72%) |
| - Weight loss | 140 (56%) |
| - Nausea/Vomiting | 100 (40%) |
| Histopathological confirmation | 245 (98%) |
| **Clinical stage at diagnosis** | |
| - Stage I (Localized) | 45 (18%) |
| - Stage II (Locally advanced) | 120 (48%) |
| - Stage III (Metastatic) | 8 (34%) |

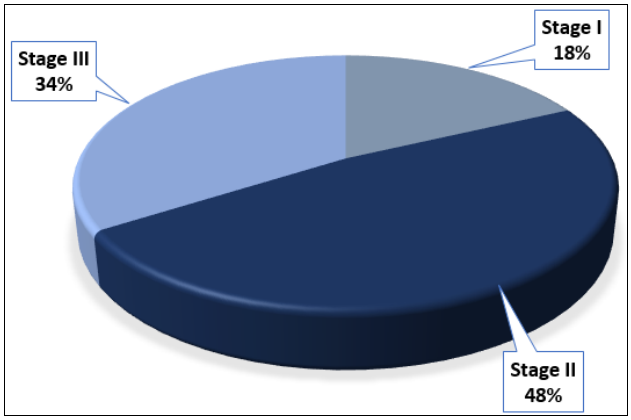


**Fig 1:** Clinical stage at diagnosis

### 2. Medical History, Physical Examination, and Laboratory Tests

Initial diagnosis of pancreatic adenocarcinoma involves a comprehensive evaluation. Including the patient's medical history physical examination and laboratory testing These measures are necessary to identify risk factors. Clinical characteristics and biochemical markers that may help in early detection and diagnosis. Important elements of medical history including diabetes, smoking, and chronic constipation (Figure 2) were recorded to assess potential risk factors. Physical examination results such as bloating, jaundice, and weight loss It is often found in patients with pancreatic cancer. In addition, laboratory tests such as blood markers such as carbohydrate antigen 19-9 (CA 19-9), liver enzymes, bilirubin levels and complete blood count It is analyzed to help with diagnosis and provide insight into the stage of the disease (Table 2).

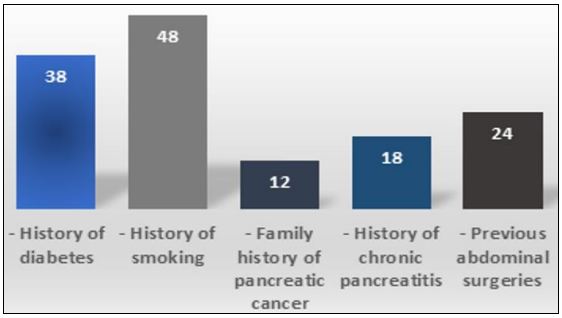


**Fig 1:** Value of Medical History

**Table 2:** Summary of Medical History, Physical Examination, and Laboratory Tests

| Parameter | Value |
|---|---|
| **Medical History** | |
| - History of diabetes | 95 (38%) |
| - History of smoking | 120 (48%) |
| - Family history of pancreatic cancer | 30 (12%) |
| - History of chronic pancreatitis | 45 (18%) |
| - Previous abdominal surgeries | 60 (24%) |
| **Physical Examination** | |
| - Abdominal tenderness | 170 (68%) |
| - Palpable mass in abdomen | 90 (36%) |
| **Laboratory Tests** | |
| - Elevated CA 19-9 (> 37 U/mL) | 180 (72%) |
| - Elevated bilirubin | 150 (60%) |
| - Elevated liver enzymes (AST/ALT) | 140 (56%) |
| - Elevated alkaline phosphatase | 130 (52%) |
| - Low hemoglobin (anemia) | 110 (44%) |
| - High white blood cell count (WBC) | 90 36%) |

3. **CT Imaging Findings and Staging**

Multidetector CT (MDCT) is performed using intravenous iodine (100-150 mL). Arteries and arteries are included to improve the detection of pancreatic tumors dilatation of blood vessels and spread the most common tumor location was the cervical head (48%) (Figure 3), followed by the body (30%) (Figure 4) and neck (22%) (Figure 5). Pancreatic head tumors Obstructive jaundice is often present because the tumor is close to blood vessels. Tumor size ranges from small (<2 cm) to large (>4 cm). Approximately 42% of tumors are 2-4 cm, while another 42% are larger than 4 cm. larger tumors are more likely. There will be blood vessel invasion. Regional lymph node involvement and spread over long distances Local vascular invasion was seen in 36% of cases, which is a common feature of advanced pancreatic cancer. Local lymph node involvement in 56% of patients indicates disease severity. Distant spread found In particular, the liver and lungs were found in 34%. These findings are of great importance in disease staging and in considering treatment options. On CT imaging, 18% of patients had localized disease (Stage 1), 48% had local metastatic disease (Stage 2), and 34% had metastatic disease (Stage 3). The majority of patients were found to have Local spread or spread. This indicates a later presentation of pancreatic cancer. CT imaging is useful in accurately determining the extent of disease and provide useful information for treatment planning (Table 3).

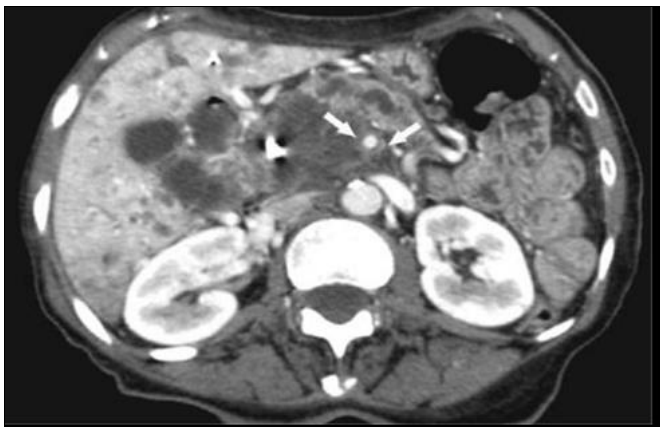

**Fig 3:** CT image shows a tumor in the head of the pancreas

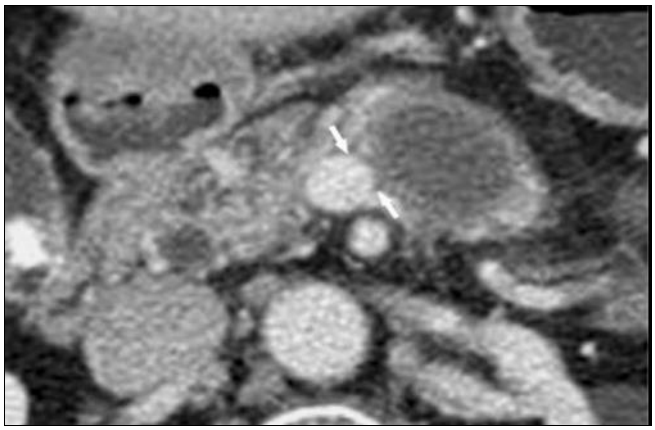

**Fig 4:** CT image shows a tumor in the body of the pancreas

**Fig 5:** CT image shows a mass in the tail of the pancreas

**Table 3:** CT Imaging Findings and Staging

| Parameter | Value |
|---|---|
| CT Imaging Protocol Used | Multidetector CT (MDCT) |
| Contrast agent | Iodinated contrast (100-150 mL) |
| Imaging phases | Arterial and venous phases |
| **Tumor location** | |
| - Head of pancreas | 120 (48%) |
| - Body of pancreas | 75 (30%) |
| - Tail of pancreas | 55 (22%) |
| **Tumor size (cm)** | |
| - ≤ 2 cm | 40 (16%) |
| - 2-4 cm | 105 (42%) |
| - > 4 cm | 105 (42%) |
| **Invasion and metastasis** | |
| - Local invasion (blood vessels) | 90 (36%) |
| - Regional lymph node involvement | 140 (56%) |
| - Distant metastasis (liver/lungs) | 85 (34%) |
| **Staging based on CT** | |
| - Stage I (Localized) | 45 (18%) |
| - Stage II (Locally advanced) | 120 (48%) |
| - Stage III (Metastatic) | 85 (34%) |

## Discussion

This has a look at provides comprehensive insights into the role of CT imaging in diagnosing and staging pancreatic adenocarcinoma, a sickness with a notoriously poor prognosis and difficult diagnostic technique. The integration of multidetector-row computed tomography (MDCT), clinical history, and laboratory findings offers vast benefits within the early detection and particular staging of pancreatic most cancers, enabling higher patient management and treatment planning.

MDCT is a critical imaging tool within the analysis and staging of pancreatic adenocarcinoma. Our findings, in line with preceding studies, verify that MDCT offers advanced delineation of pancreatic tumors, neighborhood invasion, and distant metastasis. Studies via Fletcher *et al*. (2003) [5] and Francis (2007) [7] have highlighted the capacity of MDCT to no longer most effective verify tumor length however additionally to assess vascular involvement and the respectability of pancreatic tumors. MDCT's functionality to collect multiphase imaging—arterial, pancreatic parenchymal, and venous levels—significantly complements its sensitivity in detecting tumors and predicting vascular invasion, a vital element for determining respectability (Fletcher *et al*., 2003; Vargas *et al*., 2004) [5, 22]. Our study is consistent with these findings. It was found to have high levels of CA 19-9 and an inhibition of liver fibrosis which indicates serious disease. This often must be considered for surgery. The use of thin-field CT as described by O'Malley and colleagues (1999) [16] suggests that it is useful to assess tumor growth abnormalities. This is especially true if infiltration into adjacent lymph nodes is a common feature of pancreatic cancer. Assessment of vascular invasion by MDCT has proven to be an important factor in the progression and treatment of pancreatic cancer. Vargas *et al*. (2004) [22] showed that a multiphase CT technique with curved plane deformation was effective by Especially in predicting vascular invasion and identifying indications for surgery. Our study is consistent with this. This is because CT imaging allows for a better approximation of the tumor to the main blood vessels. This is an important determinant of surgical results and outcomes. Tumor involvement of complex blood vessels such as the superior mesenteric artery (SMA) or portal vein. Often indicates a poor prognosis with limited treatment options

Moreover, Prokesch *et al*. (2002) [18] referred to that neighborhood staging the use of MDCT with curved planar reformations can enhance diagnostic accuracy, and this changed into glaring in our results, where vascular involvement turned into critical in determining tumor respectability. Incorporating scientific and laboratory findings with imaging results has verified useful in the early detection and accurate staging of pancreatic adenocarcinoma. Elbanna *et al*. (2020) [4] emphasized the importance of mixing imaging findings with tumor markers together with CA 19-9, bilirubin, and liver enzymes. The extended ranges of CA 19-9 in our cohort, discovered in 72% of patients, corroborate the application of this marker as a precious adjunct to imaging, supporting now not best in prognosis but additionally in tracking sickness development. Jaundice (64%) and increased bilirubin levels (60%) are common clinical manifestations of pancreatic cancer. This is especially true if there is a lump at the top of the abdomen that is blocking the bile duct. The combination of these clinical markers and imaging findings provides a detailed understanding of disease progression. It helps to make timely and appropriate treatment decisions. Although MDCT is very useful in evaluating pancreatic adenocarcinoma, but magnetic resonance imaging (MRI) has also been shown to complement CT in some cases. As Heiken (2001) [9] pointed out, MRI provides excellent soft tissue contrast. This may be particularly useful in evaluating tumor infiltration in peripheral tissues such as the thyroid gland or thyroid disease, although CT remains the preferred imaging modality for staging and initial evaluation Francis (2003) [6]. It is suggested that MRI may further delineate the extent of the tumor. and helps identify tissue involvement with heterogeneous CT findings. Although CT provides excellent spatial resolution and rapid imaging, But MRI's superior soft tissue contrast makes it useful in complex cases. This is especially true in younger patients or those intolerant of contrast media undergoing CT imaging.

Despite the advancements in imaging, early detection of pancreatic adenocarcinoma remains a extensive assignment,

on the whole because of the diffused nature of early-degree tumors and the absence of specific signs and symptoms. Studies by way of Pietryga and Morgan (2015) [17] and Ha *et al*. (2021) highlight that while imaging has stepped forward, pancreatic cancer is often recognized at a complicated degree due to the shortage of dependable screening techniques. Our take a look at, which targeted on patients with medical signs inclusive of jaundice, weight loss, and abdominal ache, supports this belief, as the bulk of our sufferers provided with late-level disorder. Furthermore, even as CA 19-9 is a valuable marker, Arcidiacono (2017) [1] talked about that its non-specificity limits its standalone software, emphasizing the need for comprehensive diagnostic processes that integrate imaging, laboratory markers, and scientific signs and symptoms. Our examine displays this, where increased CA 19-nine tiers helped corroborate the prognosis but couldn't serve as the sole diagnostic tool.

Future studies must focus on refining the role of MDCT and MRI in early detection, especially in excessive-threat populations. Advances in imaging technology, which includes the incorporation of artificial intelligence (AI) and gadget studying algorithms for photograph analysis, may want to similarly decorate the sensitivity and specificity of CT and MRI in identifying early-degree pancreatic tumors, as advised by Fletcher *et al.* (2003) [5]. Additionally, the development of latest molecular markers and centered imaging marketers ought to offer greater accurate, non-invasive techniques for early detection and tracking of pancreatic adenocarcinoma (Ha *et al*., 2021).

## Conclusion

This looks at highlights the essential function of CT imaging, in combination with clinical records and laboratory assessments, within the detection and staging of pancreatic adenocarcinoma. CT imaging, especially comparison-more advantageous multidetector CT (MDCT), furnished critical records concerning tumor place, length, vascular involvement, and metastatic spread, essential for accurate staging and treatment planning. Elevated CA 19-9 degrees and laboratory markers like bilirubin and liver enzymes in addition supported the diagnosis, reflecting sickness progression and ability metastasis.

Clinical signs and symptoms consisting of jaundice, belly tenderness, and weight loss had been steady with advanced levels of the ailment, emphasizing the importance of early detection. Despite the demanding situations posed by way of late-degree prognosis, the mixing of imaging with scientific and laboratory findings significantly improves diagnostic accuracy and affected person management. This multidisciplinary method is essential for optimizing treatment strategies and enhancing affected person results. Future advancements in imaging techniques and molecular markers keep promise for improving early diagnosis and therapeutic interventions in pancreatic adenocarcinoma.

## Clinical Implications

The take a look art's findings underscore the essential position of CT imaging in the control of pancreatic adenocarcinoma, mainly in staging and figuring out treatment strategies. However, CT imaging should be complemented by means of different diagnostic strategies, inclusive of laboratory tests (CA 19-9, bilirubin, liver enzymes) and physical examination, to acquire a comprehensive view of the affected person's circumstance. Early detection stays a significant assignment, for the reason that many sufferers present with superior disease. The combination of threat element identification, clinical signs and symptoms, and superior imaging modalities such as CT gives the first-class threat for enhancing early detection, correct staging, and better patient consequences.

In addition, this looks at highlights the importance of the use of a multidisciplinary approach that involves radiologists, clinicians, and oncologists to make certain top-rated treatment making plans and patient management. Through the mixing of CT imaging with scientific and laboratory statistics, clinicians can better stratify patients based on tumor respectability and capacity response to remedy, in the end improving survival quotes and fine of existence.

## Ethical Considerations

This examine became performed according with ethical recommendations and became permitted via the Institutional Review Board (IRB) of Tikrit Teaching Hospital. All patient facts were anonymized to hold confidentiality, and informed consent changed into received from all contributors for using their scientific data in the studies.

## Acknowledgments

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## Recommendations

1. Future research needs to discover the mixture of CT imaging with rising biomarkers for stepped forward early detection and staging of pancreatic adenocarcinoma.
2. Regular training of scientific specialists in superior imaging techniques can beautify diagnostic accuracy.
3. A multidisciplinary method involving radiologists, surgeons, and oncologists should be endorsed for most desirable affected person management and remedy making plans.

## Conflict of Interest

Not available

## Financial Support

Not available

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