Comparison of Endoscopic Ultrasound and Computed Tomography for the Preoperative Evaluation of Pancreatic Cancer: A Systematic Review

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Background & Aims: **It is uncertain whether computed tomography (CT) or endoscopic ultrasound (EUS) is superior for the detection, staging, and resectability of pancreatic cancer. We therefore performed a systematic literature review to determine which test is more accurate.** ***Methods:*** **We identified relevant studies from MEDLINE (1986–2004) and evaluated study quality, which was measured on the basis of guidelines for assessing studies of diagnostic tests. Quantitative outcomes data were abstracted from the studies.** ***Results:*** **Eleven studies with 678 patients satisfied inclusion criteria. Nine studies assessed tumor detection, all of which concluded that the sensitivity of EUS was superior to CT. Four of 5 studies that assessed tumor staging accuracy and 5 of 8 that assessed nodal staging accuracy concluded that EUS was superior to CT. Among the 4 studies that assessed resectability, 2 showed no difference between EUS and CT, and 1 favored each modality. Three of 11 studies met all but one of the quality criteria. The most important and frequent study limitations were lack of a consecutive series of patients and biased patient selection for surgery. Quantitative comparisons among studies were precluded by differences in tumor staging classifications, surgical selection, CT and EUS techniques, and reporting of operating characteristics.** ***Conclusions:*** **The published literature comparing EUS and CT for preoperative assessment of pancreatic cancer is heterogeneous in study design, quality, and results. All studies have methodologic limitations that potentially affect validity. Prospective studies with state-of-the-art imaging are needed to further define the role of each test.**

For the year 2005, pancreatic cancer was estimated to be the fourth and fifth most common cause of cancer death for men and women, respectively, and the second leading cause of cancer death among all gastrointestinal malignancies in the United States.[1] Despite advancements in surgical techniques and nonoperative treatments, the overall 5-year survival of 4% has remained unchanged for the last 20 years.[1] This poor survival is the result of late diagnosis and low complete resection rates.[2] Surgical resection is the only potential cure for pancreatic cancer, and complete histologic resection with negative margins is an independent predictor of postoperative survival.[3,4] At the time of surgery, less than 25% of tumors are considered potentially resectable[5–7] when defined as localized, nonmetastatic malignancy. A recent study,[8] however, found that when state-of-the-art preoperative imaging is used, 47% of 53 patients with suspected locoregional cancer had a complete resection with negative margins. Currently, there is no consensus on the optimal preoperative imaging assessment of patients with suspected or established locoregional pancreatic cancer.

Modern nonoperative techniques for tumor staging, including transabdominal ultrasound, computed tomography (CT), magnetic resonance imaging (MRI), and endoscopic ultrasound (EUS) are less invasive and less costly than surgery. These tests might help mitigate costs associated with operative management of these patients.[7] Several guidelines and opinions exist regarding the utility of these tests for staging and determination of resectability of pancreatic tumors.[2,7,9,10] However, the extent to which these guidelines are supported by the published literature is uncertain. Moreover, since publication of these guidelines, recent studies suggest that EUS might not be as accurate for preoperative stag-

Abbreviations used in this paper: CT, computed tomography; EUS, endoscopic ultrasound; FNA, fine-needle aspiration; MDCT, multidetector computed tomography; MRI, magnetic resonance imaging; N, nodal; T, tumor

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Table 1. Criteria for Study Inclusion

- Patients with suspected or proven pancreatic cancer
- Comparative testing of CT and EUS
- Outcome variables of disease stage, determination of resectability, or both
- Performance of a reference standard test (surgery) in the majority of patients

ing[8,11,12] or detection of vascular invasion of pancreatic cancer[13] as previously reported.

Within the last decade, multiple published studies with discordant results have compared EUS and CT for the diagnosis or detection, staging, and/or determination of resectability of known or suspected pancreatic cancer.[8,14–33] Because of the controversy of this issue and inconsistent findings of the published studies, we reviewed the literature systematically to determine whether EUS or CT is the superior imaging modality for preoperative assessment of suspected or established pancreatic cancer. In this review, we assessed and compared the test characteristics of EUS and CT across studies for diagnosis, staging parameters, and resectability. In addition, we evaluated the quality of each study according to published standards for assessing the validity of studies evaluating diagnostic tests. As part of study evaluation, we related all studies to a theoretical "ideal study" protocol.

Methods

Data Sources

We searched the MEDLINE database for studies published between 1986 and 2004 by using the MeSH terms "endoscopic ultrasound AND pancreatic cancer," "computed tomography AND pancreatic cancer," and "staging AND pancreatic cancer" in separate searches. The search was limited to "human only" and "English language only." To ensure the completeness of the reference list, bibliographies of the retrieved articles were cross-referenced for additional citations. Abstracts and case reports were not included.

Study Selection

Criteria for study inclusion are shown in Table 1.[34] In each study, both EUS and CT must have been performed on a group of patients with suspected or established pancreatic cancer and compared with a reference standard such as biopsy, surgery, or clinical follow-up. Studies assessing pancreatic cancer detection, staging, and/or resectability were included. Studies incorporating data on both pancreatic and ampullary neoplasms were included only if the data and analysis relating to pancreatic neoplasms were presented separately or in a manner by which it could be extracted for independent analysis. Studies were excluded if data for pancreatic neoplasms could not be extracted. When a potentially eligible study incorporated a third or fourth imaging modality for comparison, only the data relevant to CT and EUS were included. On the basis of guidelines for evaluation of articles on diagnostic tests,[35,36] we established criteria by which each study would be evaluated (Table 2).

The Ideal Study

We considered the ideal study as a reference point against which to evaluate the published literature, with particular attention to several elements of study design. First, it is important to clarify the primary study objective. Is (Are) the objective(s) to compare EUS and CT for detection of a pancreatic mass, staging accuracy, resectability, or some combination? A valid comparison of EUS and CT for detection of a pancreatic mass requires a consecutive number of patients with a broad spectrum of symptoms, signs, and preliminary test results. An ideal study would enroll consecutive patients with suspected nonmetastatic pancreatic cancer on the basis of predetermined criteria, including the results of diagnostic tests such as abdominal CT. The study population would best reflect the spectrum of patients seen in clinical practice, so that the results could be applied to that setting. Exclusion of patients who are surgically unfit and those with obvious metastatic disease on a pre-enrollment CT would be appropriate. Although using CT to screen patients for study entry might induce bias by narrowing the clinical spectrum of disease, it also selects patients who would most likely benefit from surgical resection.

Second, it is essential that both EUS and CT are performed and interpreted in a standardized, independent, and reproducible fashion. At the time of study commencement, the technology used would be state-of the-art, and each test would be performed and interpreted by a small number of experienced providers. EUS and CT would be conducted and interpreted in a blinded fashion, so that interpretation of one test would not influence that of the other.

Third, both tests must be compared to a reference standard in a blinded, independent fashion; the reference standard is surgical exploration with histopathologic correlation. The ideal protocol would ensure that every patient enrolled without confirmed or obvious distant metastasis proceeds to surgery, irrespective of the results of the 2 imaging modalities.

Table 2. Criteria Used to Assess Study Quality

- Consecutive series of patients evaluated
- Standardization of EUS and CT techniques
- Interpretation of each test independent of the other
- Unbiased determination of resectability (Did the results of the test influence the decision to do the reference standard?) (verification bias)
- Surgical examination as the reference standard
- Independent blind comparison with the reference standard test
- Inclusion of appropriate measures of diagnostic test performance for both tests (sensitivity, specificity)
- Clinical follow-up as a surrogate reference standard

Adapted from references 35 and 36.