

## REVIEW

# Pancreatic ductal adenocarcinoma staging

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### Abstract

In addition to clinical history and evaluations, the results of laboratory tests and imaging studies help clinicians in determining treatment strategies. Imaging plays a central role in the management of oncology patients including the initial diagnosis, staging, and follow-up to assess treatment response. Historically, radiologists have relied on free-style dictations to convey the results of imaging findings in radiology reports to referring clinicians. These unstructured free-style dictations can potentially be a source of frustration as the pertinent information needed to guide treatment may be omitted or difficult to extract from the report, thereby limiting its completeness and usefulness. These limitations can be overcome by adopting a structured and reproducible form of reporting imaging studies to help clinicians in deciding the best treatment strategy for each patient. There is a growing need to establish standardized radiology reporting templates for specific disease processes. One such example involves patients with pancreatic ductal adenocarcinoma, as imaging findings determine the treatment arm to which the patient is assigned. In this presentation, we outline a list of essential features that need to be included in a structured report and highlight this with illustrative case examples.

**Keywords:** *Pancreas; ductal adenocarcinoma; staging; structured reporting.*

### Introduction

Imaging plays a central role in the management of cancer patients and appropriate treatment decisions depend on accurate, detailed and comprehensive radiology reporting to optimize patient outcome<sup>[1]</sup>. Most radiologists report radiology studies using free-style dictations, which are variable and may or may not address issues that are pertinent for clinical management. Structured reporting formats can address the limitations of free-style reports by reducing the variability in free-style dictations, ensuring completeness and accuracy of the report and facilitating the use of a standardized lexicon<sup>[2,3]</sup>. Structured reporting has been shown to be equally efficient and accurate in transmitting the report content to referring clinicians as free-style reports<sup>[4]</sup>. Moreover, tabulated or itemized structured reports are more acceptable and preferred by both radiologists and clinicians<sup>[5–7]</sup>, and their use is suggested as a measure to help promote radiology practice guidelines and patient care<sup>[8,9]</sup>. In addition, the

standardized report can facilitate data extraction for use in research or development of comprehensive databases, which can also serve as local or national cancer registries. Standardized lexicon and structured reports have already been used in several subspecialty areas such as breast (breast cancer) and gastrointestinal oncology (rectal cancer) with great success<sup>[10,11]</sup>; there are increasing ongoing efforts for more future widespread use in radiology practice<sup>[12,13]</sup>. In recent years, several radiology professional organizations such as the American College of Radiology (ACR) and the Radiological Society of North America have made some progress in introducing more standardized structured templates for reporting into radiology practice.

Pancreatic cancer staging is one example where structured reporting can help to improve the quality and the completeness of the radiology report to enable assignment to the correct treatment option. Conceptualization of a structured report in pancreatic cancer requires knowledge of the imaging findings, which should then be incorporated

**Table 1** PDA reporting template

Tumor	Size:	
	Location:	
Vascular abutment	Arterial contact	Celiac axis, common hepatic artery, superior mesenteric artery ≤180° or >180°
	Venous contact	Main portal vein, superior mesenteric vein ≤180° or >180°
	Vascular thrombosis	
	Vascular anatomic variants	
Adjacent organs invasion	Inferior vena cava, aorta, adrenal gland, kidney, spleen, stomach, colon, mesocolon or small bowel	
Metastasis	Lymph nodes (local or distant)	
	Liver	
	Peritoneal space (mesentery, omentum, ascites)	
	Lungs	

into the most commonly used staging systems as well as the use of a common lexicon that is mutually understood and used by radiologists, oncologists, gastroenterologists and hepatopancreaticobiliary surgeons.

### Structured reporting in pancreatic cancer

In patients with pancreatic ductal adenocarcinoma (PDA), assigning the patient to the most appropriate type of therapy relies on making an informed decision based on all the essential imaging findings needed for accurate staging. The purpose of a radiology structured report is to provide a template that includes a comprehensive report of imaging findings of the disease process in a simplified and formatted way (see Table 1) to enable rapid and easy extraction of the necessary information by the referring physician for appropriate and optimal patient management. Depending on the imaging findings, patients with PDA are generally divided into four groups: (1) resectable, (2) borderline resectable, (3) locally advanced (unresectable) and (4) metastatic. The resectable and borderline resectable groups can be offered the chance of curative resection; locally advanced or metastatic groups are unresectable and generally offered medical therapy. This staging system primarily depends on the tumor location, extension beyond the confinement of the pancreas, adjacent vessels contact or encasement/occlusion and the presence of distant metastatic disease.

### PDA staging

Several staging systems or consensus statements developed by different societies or academic practices in the United States are used in clinical practice to stage patients with PDA. These include those developed by the American Joint Committee on Cancer (AJCC)<sup>[14]</sup>, the National Comprehensive Cancer Network<sup>[15]</sup>, the

American Hepato-Pancreato-Biliary Association, Society of Surgical Oncology, the Society for Surgery of the Alimentary Tract and the University of Texas MD Anderson Cancer Center<sup>[16]</sup>. All of these staging systems are used to stratify patient outcome or suggest best treatment approaches depending on the stage of the disease. Although the staging group or treatment suggestion for each patient may differ between the different systems, all do share common elements pertaining to tumor staging. These elements include the tumor size, location within the pancreas, extension beyond the pancreas with or without contact with the adjacent vessels, and the presence or absence of metastatic lesions. A complete and comprehensive imaging report should therefore be inclusive of at least all the above elements with the option of adding details that may affect surgical planning as per institutional protocol or preference. Multidetector computed tomography (MDCT) is the most common imaging technique used in patients with suspected or known PDA, as it is the most widely available modality and can display the imaging findings necessary to classify the disease stage. These findings as outlined in Table 1 include the following.

#### *Tumor size and location*

Tumor size when visible should be recorded. The size measurement can be used to assess the T stage of the tumor (such as used in the AJCC TNM system) at presentation or to assess treatment response at follow-up (based on RECIST criteria)<sup>[17,18]</sup>. The location of the tumor should also be noted and generally the tumor location is divided into (1) tumors located to the right of the origin of the superior mesenteric vein (i.e., pancreatic head and uncinate process) or (2) tumors located to the left of the origin of the superior mesenteric vein (i.e., pancreatic body and tail). These broadly determine the type of surgery to be performed (pancreaticoduodenectomy versus distal pancreatectomy, respectively).

### *Extension beyond the pancreas*

One major determinant of potential resectability in PDA is the presence or absence of vascular contact<sup>[19]</sup>. Vascular assessment should include the vessels in the peripancreatic region, in particular the celiac axis, superior mesenteric artery, common hepatic artery, main portal vein and superior mesenteric vein. In the presence of vascular contact, the extent of circumferential contact with the vessel ( $\leq 180^\circ$  or  $>180^\circ$ ) should be noted as this has been shown to correlate with resectability. Additional features that increase the likelihood of vascular encasement, including irregularity of the vessel contour, associated focal narrowing of the vessel caliber or tumor extension into the vessel lumen<sup>[20]</sup>, should also be reported if present. The length of vascular contact, extension to vascular branches and the presence of vascular anatomic variants (such as replaced or accessory hepatic artery branches) are also essential in planning tumor resection and primary vascular anastomosis or arterial or venous reconstruction. Based on which vessel is involved and the degree of involvement, the patient is placed in either the resectable, borderline or unresectable categories (Figs. 1–3).

Involvement of adjacent organs should also be noted, and although this may not affect the staging of the tumor, it can affect surgical planning. The common organs and structures surrounding the pancreas that can be involved by tumor extension include the inferior vena cava, aorta, adrenal gland, kidney, spleen, stomach, colon, mesocolon and small bowel.

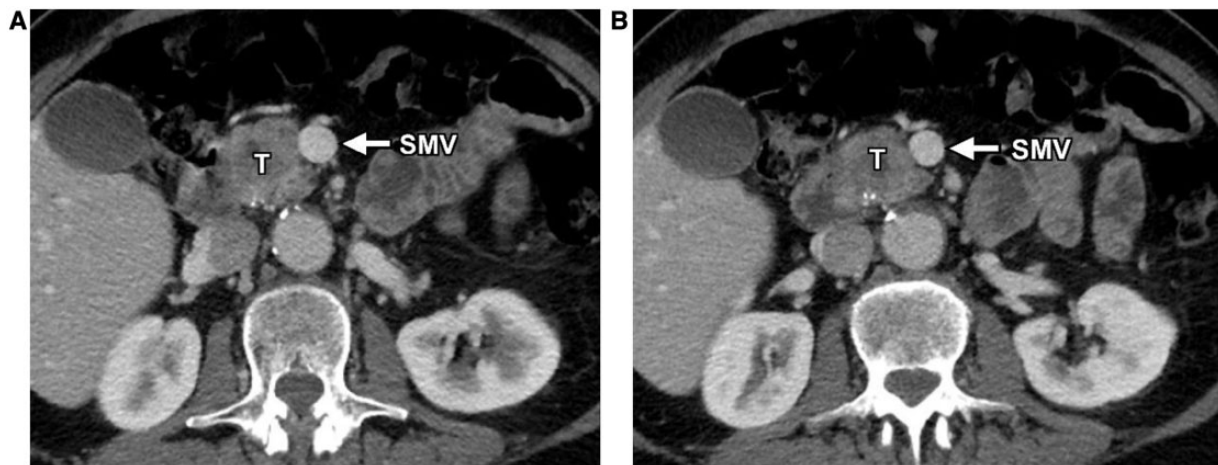
### *Metastasis*

The presence of metastatic disease excludes the patient from consideration for local curative resection intent and therefore the presence or absence of metastatic

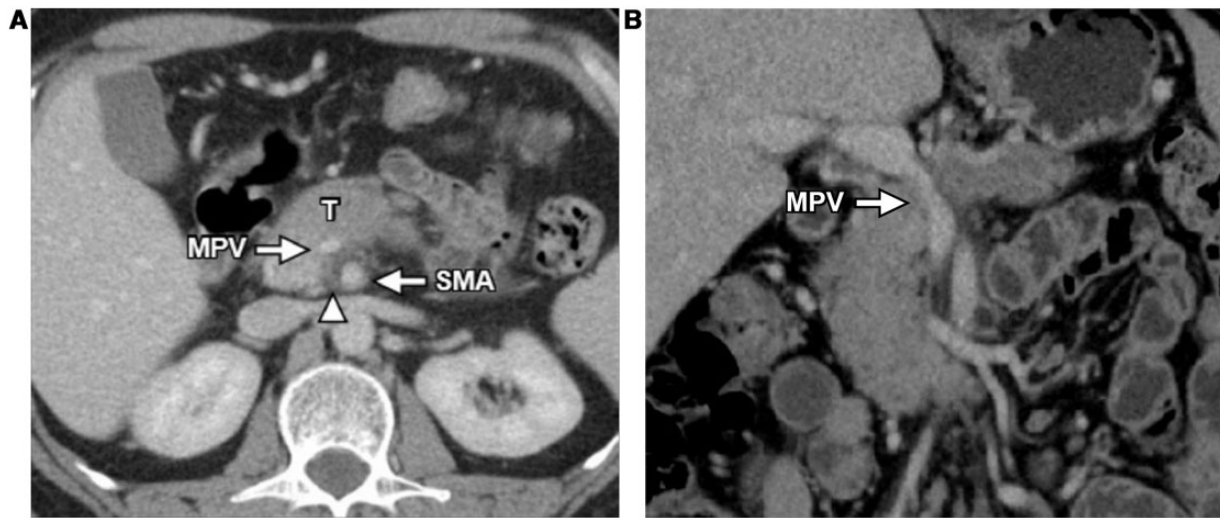
deposits should be noted<sup>[21]</sup>. Common sites of metastasis from PDA include the liver, lymph nodes, peritoneal space and lungs (Fig. 4). For liver lesions, any suspicious features (including poorly defined margins or rim enhancement) or lack of characteristic features that suggest benign liver lesions should be noted. Indeterminate or suspicious lesions may warrant further evaluation with additional diagnostic imaging tests such as magnetic resonance imaging (MRI), positron emission tomography (PET)/computed tomography (CT), or biopsy with histologic correlation. Lymph node involvement can be suspected if there is lymph node enlargement (more than 1 cm in short axis diameter, or if there are suspicious features such as round morphology or central necrosis, which have a high specificity for metastases). The location of suspicious lymph nodes should also be noted as lymph nodes present outside the normal drainage pathways of the pancreas (i.e. porta hepatis and celiac in pancreatic head tumors or celiac and splenic hilum in body/tail tumors) indicate metastatic disease (i.e. para-aortic or aortocaval). Peritoneal nodules and ascites not attributed to other causes should also be noted as these raise the likelihood of disseminated metastatic disease to the peritoneal cavity. These sites could be biopsied for histologic confirmation of metastases.

### **Conclusion**

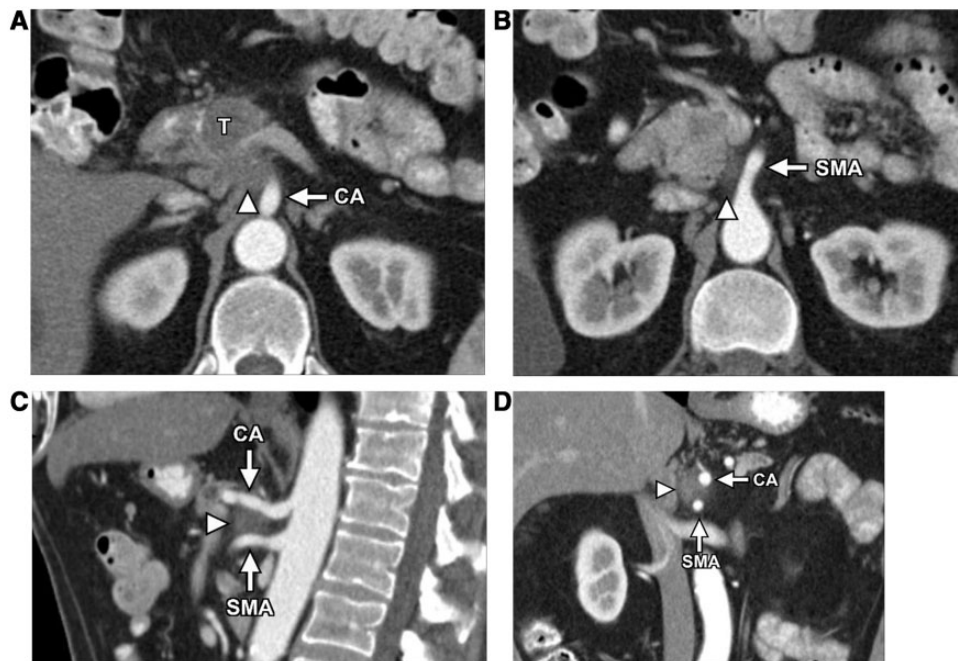
To optimize patient care in oncology, the reporting of imaging modalities frequently used in the staging and follow-up of these patients should be accurate, comprehensive, concise and easy to comprehend. In PDA, patient allocation to the different treatment options depends on accurate and complete evaluation of several imaging findings including tumor size, location within the



**Figure 1** Potentially resectable PDA. (A, B) Axial CT images demonstrate the tumor (T) in the pancreatic head showing less than  $180^\circ$  contact with the adjacent superior mesenteric vein (SMV) without change in the vessel caliber. No arterial contact is seen. Depending on the staging system used this patient can be considered as either resectable or borderline resectable.



**Figure 2** Borderline resectable PDA. (A) Axial CT image demonstrates the tumor (T) at the junction of the pancreatic head and body. There is circumferential contact with the main portal vein and apparent associated focal narrowing in the vessel caliber (MPV). There is also less than 180° contact (arrowhead) with the superior mesenteric artery (SMA). (B) The focal vessel narrowing of the MPV is better appreciated on the coronal reformatted image. The involvement of the MPV and the less than 180° contact with the SMA places the patient in the borderline resectable group.

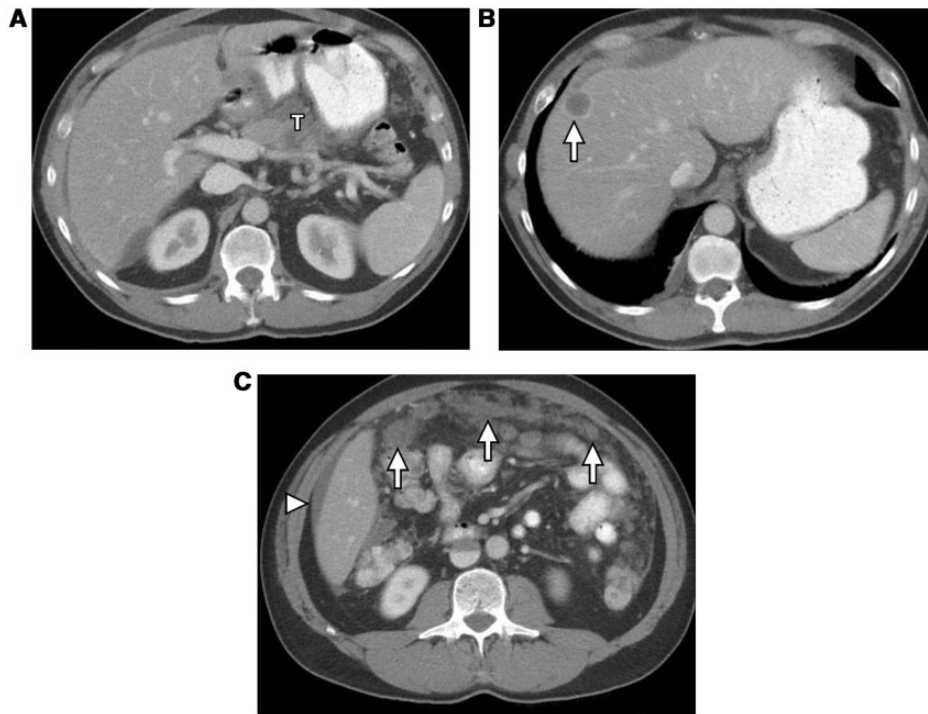


**Figure 3** Locally advanced or unresectable PDA. (A, B) Axial CT images demonstrate the tumor in the pancreatic head (T). There is tumor contact with the celiac axis (CA) and superior mesenteric artery (SMA) indicated by the arrowheads. Sagittal (C) and coronal (D) reformatted display CT images demonstrate the relationship of the tumor (arrowhead) with the CA and SMA. The involvement of the SMA and CA places the patient in the locally advanced or unresectable group.

pancreas, vascular contact and the presence of metastasis. To ensure the inclusion of all pertinent information, a structured radiology report format with the different itemized entries pertaining to each tumor attribute is suggested (Table 1). Other standardized template forms for various disease processes are already available through societies such as the Radiological Society of

North America's initiative on Structured Reporting Templates, among others. A Consensus Panel formed by members of the Society of Abdominal Radiologists and the American Pancreatic Association (APA) has been working to develop a comprehensive radiology reporting template specific to PDA and hope to publish this.





**Figure 4** Metastatic PDA. (A) Axial CT image demonstrates the tumor (T) in the pancreatic body. Multiple masses in the liver (arrow in B) and peritoneal cavity (arrows in C) with ascites (arrowhead) consistent with metastatic disease.

### Conflict of interest

The authors have no conflicts of interest to declare.

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