PET/CT

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Pancreatic cancer is one of the deadliest cancer. The 5-year relative survival rates have been very low (8.5% in Korea, 6% in US). Only 20% of all patients with pancreatic cancer are candidates for surgery.

5-yr survival rate of pancreas cancer in Korea

	1996-2000	2001-2005	2006-2010
total	7.6%	8.0%	8.0%
M	7.3%	8.0%	7.7%
F	8.1%	8.1%	8.3%

(Ministry of health and welfare, cancer registry, 2012)

5-yr survival rate of exocrine pancreas cancer in USA

Stage	5-year survival rate of exocrine pancreas 1992-1998 in USA	5-year survival rate of endocrine pancreas 1985-2004 in USA
Stage I	12-14%	61%
Stage II	5-7%	52%
Stage III	3%	41%
Stage IV	1%	15%

Pancreas tumors WHO classification

Epithelial tumors

Benign: Acinar cell cystadenoma,
Serous cystadenoma

Premalignant lesions:
Intraductal papillary mucinous neoplasm(IPMN)
Mucinous cystic neoplasm (MCN)

Malignant lesions: Ductal adenocarcinoma
Acinar cell carcinoma
IPMN with an associated invasive carcinoma
MCN with an associated invasive carcinoma
Solid pseudopapillary neoplasm (SPN)

Neuroendocrine Neoplasms:
Pancreatic neuroendocrine tumor (NET)
Gastrinoma, glucagonoma, insulinoma

Mesenchymal tumors

Lymphangioma, lipoma, solitary fibrous tumor

Lymphoma, DLBL

Role of FDG PET/CT for diagnosis of pancreas neoplasms

FDG, glucose analog, increased in tumor via up regulation of hexokinase and enhanced transport via glucose membrane transporter (GLUT) compared with normal tissue. Higash et al. found raised GLUT-1 expression in most of malignant pancreatic tumors (88%).Standardized uptake value=FDG dose in tissue (Bq/g)/injected dose(Bq)/patient weight(g). SUV is not routinely determined for diagnosis malignancy. It is commonly used for evaluation of therapeutic response. FDG PET has incremental validity in therapeutic planning in cancer. A study of prospectively collected data among the 8240 patients at 946 centers in US demonstrated FDG PET change intended management during cancer treatment: 26-28% of scans switched to another therapy and 16-19% of scans adjusted dose or duration of therapy.[1] FDG PET/CT can be used to differentiate initial malignant tumor, to stage, especially for surgical planning and RT planning, to monitor therapeutic response for tumor after therapy, to evaluate prognosis in tumor, to detect recurrent cancer. PET/CT has been used for delineating the gross tumor volume for radiotherapy. Pancreas neoplasms have been evaluated by various imaging studies, CT, MRI, ERCP, EUS and FDG PET/CT. While Korea allows PET/CT combined with non-contrast CT, as other countries can perform PET combined with

contrast enhanced (CE) CT. PET/CE CT, PET/MR can show superior performance to PET/non-contrast CT and PET. Some meta-analysis included studies of all the data using PET/CT, PET/CE CT, even PET. Thus recently reported studies of PET/CT, PET/CE CT, from 2009 to 2013 were reviewed for this presentation.

Diagnosis

FDG PET/CT can be a useful technique for preoperative work-up of patients with suspected IPMN and PET is more accurate than the international consensus guideline (ICG) in distinguishing benign from malignant IPMNs.[2] Prophylactic IPMN resection in young patients fit for surgery should be guided by the ICG, whereas PET should be performed in older patients, cases at increased surgical risk, or when the feasibility of parenchyma-sparing surgery demands a reliable preoperative exclusion of malignancy.[3] PET can be used as a valuable diagnostic and predictive tool for PC, but its effect in the staging of PC remains indeterminate. Recent two meta-analysis estimated overall pooled sensitivity and specificity of PET/CT and PET for identifying pancreatic carcinoma were 88%, 91%, and 83%, 81%, respectively.[4,5] PET/CT has a significant impact on differential diagnosis in suspected pancreatic cancer as part of the non-invasive evaluation.[6]

Staging

Some meta-analysis studies, including PET as well as PET/CT, reported relative low accuracy rates for LN staging. FDG PET/CT gives better performance combined CE CT with PET or PET/non-CE CT in comparison to those of PET. CE CT combined to PET can provide more precise delineation of the small anatomic structures. Asagi et al. evaluated with PET/CE CT compared to abdominal CT for detecting lymph node metastasis and peritoneal seeding, 51%, 53% by PET/CE CT and 45%, 31% by abdominal CE CT, respectively. In this study, PET/CE CT provided higher diagnostic accuracy rates for tumor (more than 80%) and distant metastasis (94%) in 108 patients with pancreatic cancer and in 41 patients with other pancreatic tumors.[8] PET/CT has a merit of covering whole body for detecting distant metastasis, it is a useful equipment for selecting patients accurately for surgery.

Recurrence/ restaging or therapeutic response

There were a few studies of PET/CT for assessment of treatment response or recurrence/restaging in pancreas cancer. In a PET/CT study with 49 patients previously treated for pancreatic cancer for suspected recurrence, sensitivity and specificity of PET/CE CT were 91.7%, 95.2%, respectively, where as those of PET/non-CE CT were 83.3%, 90.5%, respectively, and those of CE CT were 66.7%, 85.7%, respectively.[7] PET/CE CT is an accurate modality for assessing recurrence of pancreatic cancer. FDG PET is superior to CT in detection of treatment response after chemoradiation in 15 pancreatic cancer patients.[9] In a PET/CT study among 21 locally advanced or metastatic pancreatic cancer patients who received palliative chemotherapy, higher pretreatment SUVmax of primary pancreatic tumor was an independent prognostic factor for predicting progress free survival (PFS).[10]

Limitation and cautious interpretation

PET/non-CE CT has some difficulty in delineating local invasion in cases of showing high metabolic activity of the primary tumor, PET/CE CT seems to be superior indelineating more precise local invasion. Subcentimeter or small sized (<2cm) tumor could be false negative FDG PET/CT. As FDG is taken up in inflammatory tissue as well as cancer cells, pancreatitis which showed diffusely uptake of its parenchyma easily can be differentiated from malignancy. However, focal infection of pseudocyst or focal inflammation can be false positive PET/CT. FDG PET can provide prognostic information according to FDG uptake in tumor, FDG metabolism can looks differently by amount of mucin pooling of the tumor. Also neuroendocrine tumor can exhibitlower metabolism of FDG in comparison to those of carcinoma. Thus FDG PET/CT cautiously

can be interpreted in some cases of tumor and tumor differentiating from focal inflammation.

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Panel Discussion: Case presentation

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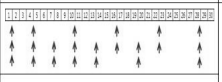
Pancreas cancer work up in Korea

- **Survey of major 7 centers**

	Preop		Postop		
	Routine	Prn	F/U	Interval	Main F/U
CT	7		7		IM (2) GS (3) Both(2) <Test order> IM (1) GS (4)
MRI	4	2			
PET	5	2 (Routine in IM without request from GS)	3	1/year vs. prn	
EUS	1	5 (Routine in IM without request from GS)			
EUS/ERCP biopsy	1	5 (Routine in IM without request from GS)			

INDETERMINATE PANCREATIC LESION