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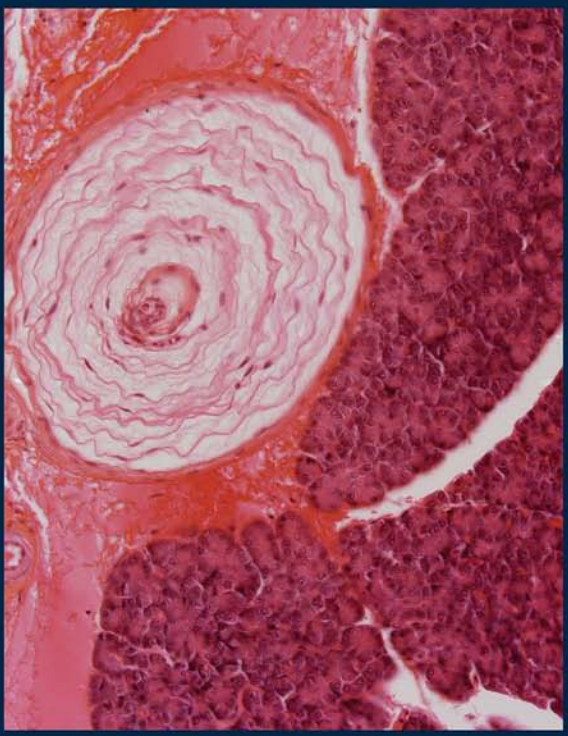
Dx/Rx

Dx/Rx: Pancreatic Cancer

Eileen O'Reilly



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Editor's Preface

I would like to welcome this latest addition to the Dx/Rx: Oncology series, *Dx/Rx: Pancreatic Cancer* by Maeve Lowery, MD, and Eileen M. O'Reilly, MD. This book represents an important contribution to the Dx/Rx family, given that cancer of the pancreas continues to be a common global illness with exceedingly poor survival. This book is wonderfully written and organized similar to other books in this series in bulleted, easy-to-read chapters divided by epidemiology, diagnosis and staging, molecular pathogenesis, and, importantly, management of both locally advanced and metastatic disease. The timing of this book could not be better, given the recent positive results of the FOLFIRINOX regimen in this disease (presented at ASCO 2010), after a series of negative phase III studies. Drs. O'Reilly and Lowery also provide important management guidance for supportive care for pancreatic cancer, as well as a look to the future with new biologic agents being explored in this disease. I am certain you will find this book both informative and an easy-to-read pocket resource as you manage this complex and difficult malignancy.

Manish A. Shah, MD

CHAPTER 1

Epidemiology

Epidemiology

- Pancreatic ductal adenocarcinoma (PDAC) is the fourth most common cause of cancer death in the United States and is disproportionally high on this list when compared to leading causes of cancer incidence, where it ranks fourth.
- PDAC is the 10th most common cancer in men and women, accounting for 3% of all new cancer diagnoses; 42,470 new cases of pancreatic cancer and 35,240 pancreatic cancer–related deaths are estimated in the United States in 2009.[1] In Europe, the estimated incidence in 2008 was 68,500 and mortality was 70,200.[2]
- Median age at diagnosis is 72 years. The age-adjusted incidence rate is 11.7 per 100,000 men and women per year. The incidence in men has remained stable since 1976, while the incidence in women has increased modestly.[3]
- The overall 5-year survival rate for all races and both sexes is 5.5%.[4]

Risk Factors

Age and Gender

- Pancreatic cancer is rare below the age of 45 years and most frequently occurs in the seventh and eighth decades of life. It is slightly more common in males than females, but does not show the significant male predominance seen in most other cancers of the gastrointestinal tract. The highest incidence worldwide is seen in New Zealand Maoris, African Americans (but not African men), and native Hawaiians, while Indian and Nigerian men have the lowest reported rates.[5] (See **Figure 1.1**.)

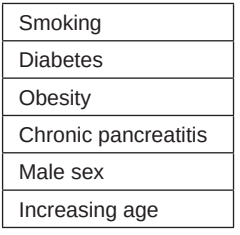

Figure 1.1 Risk factors for the development of pancreatic ductal adenocarcinoma.

Type I and II Diabetes Mellitus

- An association between type II diabetes and pancreatic cancer has been clearly demonstrated in several large population-based studies; however, a causal relationship has been more difficult to prove. A meta-analysis of 17 case-control studies and 19 cohort studies involving 9220 people found evidence of a modest causal association, with an age- and sex-adjusted odds ratio of 1.82 (95% CI: 1.66–1.89).[6] The risk of pancreatic cancer was 50% higher in those diagnosed with diabetes within the previous 5 years (odds ratio 2.1 vs. 1.5, $p < 0.005$).
- A subsequent population-based study looked at 2122 newly diagnosed diabetics age older than 50 years. Eighteen (0.85%) developed pancreatic cancer within 3 years, indicating that patients with a new diagnosis of diabetes are 8 times more likely than nondiabetics to develop pancreatic cancer.
- Regarding type I or early onset diabetes and pancreatic cancer risk, a systematic review looked at 3 cohort and 6 case-control studies. The total number of patients identified was small, only 39; however, they found a similar increased risk for development of pancreatic cancer as previously seen with type II diabetes (relative risk 2.0, 95% CI 1.37–3.01).[7]
- More recently, a case-control study demonstrated a lower risk of pancreatic cancer in diabetic patients treated with metformin, compared to those who had not received it (RR 0.38, 95% CI 0.22–0.69, $p = .001$). There was also

a trend toward increased risk of pancreatic cancer among patients treated with insulin or insulin secretagogues.

Cigarette Smoking

- Cigarette smoking has been shown in several large cohort and case-control studies to approximately double the risk of developing pancreatic cancer, and it accounts for 25% of all cases diagnosed each year.[8] The risk has been shown to correlate with duration and intensity of smoking, and decreases with smoking cessation. A large meta-analysis of 82 published studies found that cigarette smoking was associated with a 75% increased risk of development of pancreatic cancer, and that an increased risk persisted in former smokers for at least 10 years.[9]
- More recently, published data from the Pancreatic Cancer Cohort Consortium supported this finding.[10] They again demonstrated that current smokers had a significantly elevated risk of development of pancreatic cancer (OR = 1.77, 95% CI: 1.38, 2.26). The risk increased significantly with greater intensity, duration, and cumulative smoking dose. The risk for former smokers more than 15 years after smoking cessation was similar to that for those who had never smoked.

Pancreatitis

- Chronic pancreatitis is associated with pancreatic carcinoma; however, a causal relationship has been more difficult to establish. Common risk factors for both conditions may confound the picture. While some studies have reported up to a 28-fold increased risk for development of pancreatic cancer following diagnosis with chronic pancreatitis, further large case-control studies have suggested a more modest association.[11] A recently published case-control study found that a positive history of pancreatitis was associated with pancreatic cancer with an odds ratio of 4.68 (95% CI, 2.23–9.84).[12] While acute pancreatitis is not a risk factor for PDAC, approximately 3% of all invasive cancers present with an episode of acute pancreatitis. Hereditary pancreatitis is

associated with a greatly increased risk of PDAC and is discussed below.

Diet

- An association between obesity and pancreatic cancer is biologically plausible based on the known association with type II diabetes. A meta-analysis of 21 prospective studies confirmed a 12% increase in risk of pancreatic cancer for a 5 kg/m^2 increase in body mass index (BMI).[13] A multicenter observational study looked at 161,808 postmenopausal women and found no association between BMI and pancreatic cancer incidence; however, an increasing waist-to-hip ratio was associated with an increasing risk of pancreatic cancer, suggesting a possible relationship to centripetal obesity and insulin resistance.[14]

Familial Pancreatic Adenocarcinoma

- Approximately 7–10% of all PDAC is related to genetic factors. There are several well-defined genetic syndromes known to predispose to PDAC; however, in up to 70% of cases a significant family history with multiple family members diagnosed with PAC is seen, but no specific genetic abnormality is identified.[15]
- The familial component to pancreatic cancer etiology was established initially by several case reports and early population-based studies from the 1970s onward. The National Familial Pancreas Tumor Registry (NFPTR) was established in 1994 to prospectively observe relatives of patients with PDAC and assess their prospective risk.[15] Eight hundred thirty-eight relatives of patients with PDAC were followed and their prospective risk of development of PDAC was calculated by comparing the observed to expected numbers of cases based on Surveillance Epidemiology and End Results (SEER) data. It was shown that people with 3 first-degree relatives with pancreatic cancer had a 32 times increased risk of developing PDAC. In those with 2 first-degree relatives the risk was increased by 6.4-fold, and those with 1 relative with PDAC had a 4.6-fold increased risk of developing the disease. It was concluded

that this clustering of PDAC in families is due in part to a yet unidentified gene, in combination with shared environmental factors.

Genetic Conditions Associated with Pancreatic Ductal Adenocarcinoma

BRCA 1 / 2 Mutations

- Germline BRCA 1 and 2 mutations have been clearly identified as carrying an increased lifetime risk of PDAC. A large series looking at BRCA 2 mutation-carrying families estimated an increased risk of 3.5 times the population risk.[16] The risk in BRCA 1 mutation carriers has been shown to be somewhat lower, with a relative risk of 2.2 compared to the general population.[17] The Ashkenazi Jewish population has an increased carrier frequency of BRCA 1 and 2 germline mutations, so a lower threshold for genetic screening in Jewish patients presenting with PDAC is appropriate. Increased sensitivity to DNA cross-linking agents such as mitomycin, cisplatin, and carboplatin has been demonstrated in other BRCA associated malignancies; anecdotal reports suggest that this may also be true for BRCA mutation–associated pancreatic cancer. Poly ADP-ribose polymerase (PARP) inhibitors have shown promising results in BRCA mutation–associated breast and ovarian cancer; ongoing clinical trials are currently evaluating the use of PARP inhibitors in the PDAC population with both a known BRCA mutation and in the sporadic population. (See **Table 1.1**.)

Peutz-Jeghers Syndrome

- This is an autosomal dominantly transmitted hereditary condition, characterized by hyperpigmentation of the buccal mucosae and lips, along with hamartomatous polyps of the gastrointestinal tract. Eighty percent of cases are due to a germline mutation in the STK11/LLDI gene. The condition is associated with multiple cancers of the gastrointestinal tract, lung, breast, and gynacological cancers. The estimated increased risk of PDAC is estimated at 132.[18]

Table 1.1 Hereditary Conditions Associated with Increased Risk of Pancreatic Ductal Adenocarcinoma

Condition	Gene	Relative risk of PAC
BRCA 1 mutation BRCA 2 mutation	BRCA 1 / 2	2.2 3.5
Hereditary non-polyposis colorectal cancer (HNPCC)	MSH1/2, PMS1/2, and MSH6	Uncertain
Familial adenomatous polyposis (FAP)	APC gene	4.0
Familial atypical malignant mole and melanoma (FAMMM)	p16/CDKN2A	38.0
Hereditary pancreatitis	Trypsinogen / SPINK-1	53.0
Peutz-Jeghers syndrome	STK11/LLDI	132

Interestingly, in this population the development of invasive pancreatic cancer appears to arise via the Intraductal Papillary Mucinous Neoplasm (IPMN) pathway, making screening for this population an attractive concept.

Hereditary Pancreatitis

- This is a rare inherited condition characterized by recurrent episodes of acute pancreatitis. It arises due to a hereditary defect in the trypsinogen gene in the autosomal dominant form, or in the SPINK1 gene in the autosomal recessive form. It carries an estimated increased risk of pancreatic cancer of 53-fold higher compared to the general population, with 30–40% of sufferers anticipated to develop invasive pancreatic cancer by the age of 70 years.[19] In this population pancreatic cancer has been shown to occur significantly earlier in smokers compared to nonsmokers.[20]

Hereditary Non-Polyposis Colorectal Cancer (HNPCC)

- This is an autosomal dominant condition resulting from a germline mutation in genes encoding for proteins responsible for DNA repair, including the MSH1/2, PMS1/2, and MSH6 genes. It not only carries an increased risk of colon cancer but also predisposes to endometrial, ovarian, gastric, renal, and urinary tract cancers. HNPCC also has been shown to carry an increased risk of pancreatic and biliary cancers, but this risk has been difficult to quantify.[21]

Familial Atypical Multiple Mole and Melanoma Syndrome (FAMMM)

- This is an autosomal dominantly inherited condition resulting from a germline mutation in the p16/CDKN2A gene. It carries an increased risk of melanoma, breast cancer, lung cancer, and sarcoma as well as pancreatic cancer. The estimated increased risk of developing PDAC compared to the general population is estimated at a 38-fold increased risk.[22]

Familial Adenomatous Polyposis (FAP)

- This is an autosomal dominant condition arising from a germline mutation in the APC tumor suppressor gene. Affected individuals develop multiple colonic adenomatous polyps, resulting in an almost absolute risk of developing adenocarcinoma of the colon by age 40 years. Other associated cancers include thyroid, gastric, duodenal, and ampullary carcinomas. It also carries a 4-fold increased risk of pancreatic carcinoma.[23] An association with pancreaticoblastoma has also been described, a connection between the 2 conditions being plausible via the APC/Wnt pathway.

Screening in High-Risk Patients

- The benefit of screening of patients at high risk for development of pancreatic adenocarcinoma based on family history or on known predisposing germline mutation is

currently under investigation. Options include the use of endoscopic ultrasound (EUS) with FNA as indicated, or CT or MRI cross-sectional imaging. EUS allows evaluation of the pancreatic duct for areas of dilatation or focal narrowing or wall thickening and provides a useful means for obtaining histological diagnosis.

- The estimated diagnostic yield from screening programs published to date ranges from 3.9% to 23% for prevalent invasive cancers. However, there is considerable heterogeneity among the population screened between different institutions and also in the diagnostic tests used. The series from Johns Hopkins included patients with Peutz-Jeghers syndrome (screened from age 30 years onward) and familial pancreatic patients (> 3 first-degree relatives with pancreatic cancer) from age 50 years onward. In this high-risk group of patients, the diagnostic yield for moderate or severe dysplasia was 95.8% and 33% for IPMN with high-grade dysplasia or PANIN 3. Surgical resection was well tolerated in these patients; long-term data regarding survival are pending.
- Prospective data regarding the results of large screening programs are awaited. The CAPS 5 trial is currently recruiting and will provide long-term data regarding the benefit of screening high-risk patients for pancreatic cancer. A key area of intense research at present is the search for biomarkers, both in blood and in pancreatic fluid, to incorporate into screening programs with EUS or cross-sectional imaging. For the general population at large, no routine screening has been shown to be of use and is not recommended.
- Young patients presenting with sporadic pancreatic cancer should be encouraged to attend a clinical geneticist for discussion regarding genetic screening; relatives of these patients and those with a known predisposing genetic mutation should be encouraged to partake in clinical trials of screening and prevention and to enroll in prospective registry studies. Smoking cessation is also of paramount importance in this population, given that it represents the only reversible risk factor.

References

1. Jemal A, Siegel R, Ward E, et al. Cancer statistics, 2009. *CA*. 2009;59:225–249.
2. Ferlay J, Parkin DM, Steliarova-Foucher E. Estimates of cancer incidence and mortality in Europe in 2008. *Eur J Cancer*. In press, corrected proof.
3. Edwards B, Ward E, Kohler B, et al. Annual report to the nation on the status of cancer, 1975–2006, featuring colorectal cancer trends and impact of interventions (risk factors, screening, and treatment) to reduce future rates. *Cancer*. 2010;116:544–573.
4. Ducreux M, Boige V, Gor D, et al. The multidisciplinary management of gastrointestinal cancer. Pancreatic cancer: from pathogenesis to cure. *Best Pract Res Clin Gastroenterol*. 2007;21:997–1014.
5. Ghadirian P, Lynch HT, Krewski D. Epidemiology of pancreatic cancer: an overview. *Cancer Detect Prev*. 2003;27: 87–93.
6. Huxley R, Ansary-Moghaddam A, de Gonzlez AB, et al. Type-II diabetes and pancreatic cancer: a meta-analysis of 36 studies. *Br J Cancer*. 2005;92:2076–2083.
7. Stevens RJ, Roddam AW, Beral V. Pancreatic cancer in type 1 and young-onset diabetes: systematic review and meta-analysis. *BrJ Cancer*. 2007;96:507–509.
8. Coughlin SS, Calle EE, Patel AV, et al. Predictors of pancreatic cancer mortality among a large cohort of United States adults. *Cancer Causes Control*. 2000;11:915–923.
9. Iodice S, Gandini S, Maisonneuve P, et al. Tobacco and the risk of pancreatic cancer: a review and meta-analysis. *Langenbecks Arch Surg*. 2008;393:535–545.
10. Lynch SM, Vrieling A, Lubin JH, et al. Cigarette smoking and pancreatic cancer: a pooled analysis from the Pancreatic Cancer Cohort Consortium. *Am. J. Epidemiol*. 2009;170:403–413.
11. Karlson BM, Ekbom A, Josefsson S, et al. The risk of pancreatic cancer following pancreatitis: an association due to confounding? *Gastroenterology*. 1997;113:587–592.
12. Maisonneuve P, Lowenfels A, Bueno-de-Mesquita HB, et al. Past medical history and pancreatic cancer risk: results from a multicenter case-control study. *Ann Epidemiol*. 2010;20:92–98.
13. Larsson SC, Orsini N, Wolk A. Body mass index and pancreatic cancer risk: a meta-analysis of prospective studies. *Int J Cancer*. 2007;120:1993–1998.
14. Luo J, Margolis KL, Adami HO, et al. Obesity and risk of pancreatic cancer among postmenopausal women: the

Women's Health Initiative (United States). *Br J Cancer*. 2008;99:527–531.
15. Klein AP, Brune KA, Petersen GM, et al. Prospective risk of pancreatic cancer in familial pancreatic cancer kindreds. *Cancer Res*. 2004;64:2634–2638.
16. Breast Cancer Linkage Consortium. Cancer risks in BRCA2 mutation carriers. *J Natl Cancer Inst*. 1999;91:1310–1316.
17. Brose MS, Rebbeck TR, Calzone KA, et al. Cancer risk estimates for BRCA1 mutation carriers identified in a risk evaluation program. *J Natl Cancer Inst*. 2002;94:1365–1372.
18. Giardiello FM, Brensinger JD, Tersmette AC, et al. Very high risk of cancer in familial Peutz-Jeghers syndrome. *Gastroenterology*. 2000;119:1447–1453.
19. Lowenfels A, Maisonneuve P, DiMagno E, et al: Hereditary pancreatitis and the risk of pancreatic cancer. International Hereditary Pancreatitis Study Group. *J Natl Cancer Inst*. 1997;89:442–446.
20. Lowenfels AB, Maisonneuve P, Whitcomb DC, et al. Cigarette smoking as a risk factor for pancreatic cancer in patients with hereditary pancreatitis. *JAMA*. 2001;286:169–170.
21. Lynch HT, Voorhees GJ, Lanspa SJ, et al. Pancreatic carcinoma and hereditary nonpolyposis colorectal cancer: a family study. *Br J Cancer*. 1985;52:271–273.
22. Lynch H, Fusaro R, Lynch J, et al. Pancreatic cancer and the FAMMM syndrome. *Fam Cancer*. 2008;7:103–112.
23. Giardiello FM, Offerhaus GJ, Lee DH, et al. Increased risk of thyroid and pancreatic carcinoma in familial adenomatous polyposis. *Gut*. 1993;34:1394–1396.

CHAPTER 2

Diagnosis and Staging

Diagnosis

Diagnostic Tests

Ultrasound

- Transabdominal ultrasound is usually the first diagnostic test obtained in a patient presenting with obstructive jaundice or elevation of liver function tests. Liver metastases, biliary dilatation, or a pancreatic mass may be appreciated on ultrasound alone. The sensitivity of ultrasound for detection of a pancreatic exocrine tumor has been reported as up to 90% in high-volume centers.[1]

CT Imaging

- Computerized tomography of the pancreas remains the imaging modality of choice for detection and staging of pancreatic adenocarcinoma. Advances in imaging techniques and the development of spiral and multidetector row CT (MDCT) scanners have improved the accuracy of pancreatic CT imaging. MDCT[2] and spiral CT allow for rapid image acquisition timed with administration of intravenous contrast medium, and so can selectively opacify the venous, arterial, or portal venous systems.
- The sensitivity of MDCT for detection of pancreatic tumors in reported series ranges from 76% to 91%, but is somewhat less than this for tumors smaller than 2 cm.[3]
- Adherence to a specific technique is essential for good-quality imaging of the pancreas and surrounding vessels. High-density oral contrast agents are not given; instead, water is used to aid visualization of the duodenum and small bowel. Intravenous contrast is administered by fast injection for optimal enhancement of the pancreatic parenchyma and surrounding vasculature. Images are

rapidly acquired during arterial, venous, and portal venous phases.[4] Images obtained can now be reconstructed using 3D imaging with volume rendering software, with the ability to alter parameters, enabling optimal visualization of the pancreas parenchyma or of the vessels.

- Liver metastases are best seen during the portal venous phase of enhancement and usually appear as low-attenuation lesions compared to normally enhancing liver.[4] The sensitivity of CT for detection of liver metastases has been reported as approximately 75%, with missed lesions commonly being those < 1cm in diameter or located on the surface of the liver.[5]

MRI

- Pancreatic adenocarcinomas typically appear on MRI as hypointense tumors on T1-weighted fat-suppressed images, and as hypointense lesions on arterial phase gadolinium enhanced imaging. T2-weighted images are used for detection of liver metastases.
- Multiple studies comparing MDCT to MRI imaging for diagnosis and staging of pancreatic adenocarcinoma have shown no benefit from MRI over MDCT. More recent studies have suggested that recent advances in MDCT techniques may render it superior to MRI for the evaluation of pancreatic lesions.[6]
- As an MRI is more costly, longer in duration of study, and offers poor visualization of the lungs when compared to CT, its use is usually reserved for evaluation of the pancreas when biliary dilatation is detected on CT with no mass visible, or for the evaluation of liver lesions indeterminate on CT imaging.[6]

Endoscopic Ultrasound (EUS)

- The role of EUS in pancreatic malignancy has evolved from its initial application in diagnosis and staging to include celiac plexus block techniques for palliation of pain and radiofrequency ablation. The potential therapeutic role of endoscopic techniques in the management of inoperable pancreatic cancer is discussed in Chapter 8.

- EUS has been shown to be superior to CT imaging for the detection of pancreatic lesions and also more accurate for staging of ductal adenocarcinoma.[7] It allows direct visualization of lesions as small as 2–3 mm and has the added advantage of enabling tissue diagnosis to be obtained by fine needle aspiration (FNA).
- EUS evaluation of the pancreas is indicated when there is a suspicion of malignancy on CT imaging but no distinct mass is identified, or to confirm the presence of locally advanced disease when CT imaging is equivocal.[8]
- EUS-guided FNA is an efficient and cost-effective method to obtain histological diagnosis, especially for small pancreatic lesions. It has been shown to be at least equivalent to image-guided FNA of pancreatic lesions in terms of sensitivity, specificity, and diagnostic accuracy.[9] It has also been shown to have a lower association with peritoneal seeding than percutaneous FNA. Given the high diagnostic yield, low risk of tumor seeding, and additional advantages in imaging and staging, EUS-guided FNA is the preferred method of obtaining histological diagnosis.
- It is worth noting, however, that histological diagnosis is not always mandated prior to surgical resection. In a patient who has both a typical clinical presentation and radiological features consistent with pancreatic cancer, preoperative biopsy is unlikely to alter management and is not routinely recommended.[10] Pancreatic ductal carcinomas frequently have a surrounding inflammatory or desmoplastic component, which can result in a false negative biopsy result. If a patient is being considered for neoadjuvant or palliative therapy, however, tissue diagnosis is required prior to initiation of treatment.

Endoscopic Retrograde Cholangiopancreatography (ERCP)

- ERCP is predominantly used with therapeutic intent for relief of obstructive jaundice, as discussed in Chapter 8. ERCP images may demonstrate the classical double duct sign of dilatation of the common bile duct and the pancreatic duct.