

# National Patterns of Care for Pancreatic Cancer

## Results of a Survey by the Commission on Cancer

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### Background

The Commission on Cancer of the American College of Surgeons conducted a large, national survey to assess methods of diagnosis, American Joint Commission on Cancer staging, treatment, and outcome of patients with adenocarcinoma of the pancreas.

### Study Design

The survey questionnaire contained 160 questions and covered two study periods, 1983 to 1985 and 1990, for time-trend analysis. Nine hundred seventy-eight institutions throughout the United States voluntarily participated, contributing 8917 case reports for 1983 to 1985 and 8025 reports for 1990, resulting in a total of 16,942 patient reports. Most, but not all, of the participating hospitals maintain approval status with the Commission on Cancer of the American College of Surgeons.

### Results

The ratio of male-to-female cases was 1:1. Patient characteristics including age, ethnicity, neighborhood income, type of insurance coverage, and hospital characteristics—including annual caseload and type of facility (e.g., teaching, community)—appeared to influence surgical multimodality treatment patterns. The most common presenting symptom was abdominal pain. The reported history of smoking for these patients with pancreatic cancer was higher than U.S. population averages. The frequency of using abdominal computed tomography scans, endoscopic retrograde cholangiopancreatography, carcinoembryonic antigen, and CA 19-9 during patient evaluation all increased. Time trends toward lower operative mortality and more extirpative surgery were reported, as was a slightly higher survival for those patients who were resected surgically.

### Conclusions

Pancreatic cancer continues to be a disease of older patients. There were slight improvements in operative mortality. For a highly selective category of patients, cancer-directed surgery offers a

chance for cure with excellent operative mortality and acceptable complication rates, especially when performed in institutions that have a 20 or greater case per year experience.

Since 1973, the yearly incidence of adenocarcinoma of the pancreas in the United States has remained constant at nine new cases per 100,000 population. Unfortunately, mortality from this cancer approximates this incidence, maintaining pancreatic cancer as the fourth leading cause of cancer death in men and the fifth in women.<sup>1</sup> Less than 20% of incident cases survive 2 years, and only 3% are alive at 5 years.<sup>1,2</sup>

Despite the poor prognosis for this tumor, a remarkable change has been observed regarding the safety of the extensive surgery required for attempted cure.<sup>3-5</sup> From operative mortality rates of approximately 25% in the 1960s and 1970s, current evidence suggests operative deaths to be in the range of 1% to 3% in large centers performing 40 or more pancreatic resections each year. Such reports also have suggested that patients with successful operations also were enjoying improved 5-year survival.<sup>3,5</sup>

These reports prompted a study conducted by the Commission on Cancer for the American College of Surgeons of the patterns of care associated with adenocarcinoma of the pancreas using hospital cancer registry data.<sup>6</sup> The purpose of this initial study was to document the current methods of diagnosis, the frequency in which various treatment options were applied, the morbidity and mortality associated with therapy, and patient survival, and, most importantly, to identify changing trends in these parameters over the study periods. This was accomplished by surveying cancer registries throughout the United States.

## METHODS

### Study Design

In February 1991, the Commission on Cancer invited the cancer committees in each of approximately 1250 commission-approved, hospital-based cancer programs, and 800 other hospitals with cancer registries, to voluntarily participate in a retrospective study of pancreatic cancer, including both a long- and short-term cohort. The objective of the long-term study was to obtain detailed care information and 5-year survival data for pa-

tients with adenocarcinoma of the pancreas. The objective of the short-term study was to provide a current profile of patterns of care and enable time-trend analysis.

The study was designed to include all histologically confirmed cases of adenocarcinoma of the pancreas, including International Classification of Diseases for Oncology (ICD-O-2)<sup>7</sup> codes 8031 through 8560 (adenocarcinoma of the pancreas), specifically excluding endocrine tumors, carcinoid tumors, ampullary carcinomas, duodenal cancers, and distal bile duct carcinomas. Patients with prior treatment for cancer of the pancreas also were excluded.

### Selection of Cases

Initially, detailed data collection forms were field-tested for ease of use and accuracy of completion. The finalized survey was distributed to participating cancer registries in June of 1992. Participating hospitals were requested to report on 25 or fewer consecutive patients who received treatment during the calendar years 1983 to 1985 (long-term study), and 25 or fewer consecutive patients who were treated during calendar year 1990 (short-term study). Hospitals admitting fewer than 25 patients were to include all cases seen during that year.

Data collection was completed by December 1, 1993, with 978 institutions reporting data on 16,942 patients. Most of the cases were reported from hospitals with Commission on Cancer approval status as teaching hospitals, community-comprehensive cancer centers, or community cancer centers, as defined in the Commission's *Cancer Program Manual*.<sup>8</sup> Community comprehensive cancer centers are differentiated from community cancer centers because the former accession more than 300 analytic cancer cases per year and meet a weekly conference requirement.

### Questionnaire Design

There were more than 160 data items for each patient in the survey questionnaire. Specific questions concerned the nature of patient presentation at diagnosis, preoperative evaluation, intraoperative treatment, postoperative care, use of adjuvant therapy, and follow-up. Staging information was based on the 1988 edition of the American Joint Commission on Cancer (AJCC) staging manual.<sup>9</sup>

### Presentation of Data

Observations that follow resulted from data recorded for multiple demographic and pathologic factors, includ-

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**Table 1. PERCENT OF PANCREATIC CANCER CASES TESTED AND PERCENT POSITIVE OF THOSE TESTED BY DIAGNOSTIC TEST AND STUDY YEAR**

Test	% Tested		% Results Suggesting Cancer of Those Tested	
	1983-1985	1990	1983-1985	1990
Chest X-ray	82	81	7	7
Abdominal CT scan	79	88	88	87
Abdominal ultrasound	52	48	65	65
Upper gastrointestinal examination, barium	42	31	24	25
Endoscopic retrograde cholangiopancreatography	26	38	67	72
Preoperative carcinoembryonic antigen	25	33	27	26
Liver scan	22	11	46	46
Percutaneous transhepatic cholangiography	16	11	71	66
Bone scan	12	11	16	17
Chest CT scan	8	11	30	30
Angiography	7	7	44	37
Brain scan	7	8	6	6
Laparoscopy	6	6	58	60
CA 19-9	3	19	15	33
Magnetic resonance imaging	3	5	11	30

CT = computed tomography.

Number of cases: 1983-1985, 8917; 1990, 8025. Total percentages > 100 due to multiple responses.

ing the following: sex, age, ethnicity, zip code, income, geographic distribution (census region, urban/rural status), and reporting hospital size and type. The AJCC stage, anatomic subsite within the pancreas, and tumor grade were pathologic features examined for both their distribution and their impact on treatment survival.

Stage is presented as "combined AJCC stage group," defined as the pathologic stage group where documented, augmented by the clinical AJCC staging when pathologic stage is not available.<sup>9</sup> Surgical procedures were coded using the data acquisition manual<sup>10</sup> of the Commission on Cancer. Noncancer-directed surgery codes were 01 through 07, including biopsy, bypass operations, and exploration only. "Unknown if surgery done" was coded as 09. Cancer-directed surgery codes included the following: 10—local or partial excision of pancreas; 20—total pancreatectomy; 30—Whipple procedure; 40—radical pancreatectomy (partial) with node dissection; 50—pancreatectomy not otherwise specified; and 80—operation of regional and distant sites only. For analysis purposes, these were then placed into the following groups: no cancer-directed surgery (codes 0-9, 10-19, 80-99) and cancer-directed surgery (codes 20-59).

The coding schema used for type of hospital, urban/rural status, income, and U.S. census geographic region have been described elsewhere.<sup>11</sup>

With regard to analysis, the data have been presented in descriptive and stratified form (cross-tabulations), so that putative associations can be assessed directly with-

out mathematical formulation. Significance tests are not considered appropriate to the nature of these descriptive data and could possibly be misleading, so they are not presented. Survival was calculated using estimated survival probabilities as described in the AJCC staging manual.<sup>9</sup> The aggregate survey data are presented in summary tables. For some tables, cases have been omitted that were reported from hospitals that use nonstandard codes or that did not collect the variable under analysis.

## RESULTS

There were 8917 pancreatic cancers reported as accessioned in 1983 to 1985, and 8025 in 1990 from 978 institutions. The distribution of the hospital's annual pancreas cancer caseload showed no significant changes between the study periods. Sixteen percent of the cases were reported from institutions with more than 20 pancreatic cancer cases per year, 35% with 11 to 20 per year, 17% with 6 to 10 per year, 10% with less than 6 per year, and 16% from institutions whose total caseload was unreported. Of the hospital categories used by the Commission on Cancer, teaching institutions submitted approximately 25% of the cases, comprehensive community hospitals (*i.e.*, more than 300 total cancers per institutions per year) submitted 36%, and community hospitals (less than 300 annual cancers) submitted 30%. Nine percent were from hospitals without approval status.

In 1990, 79% of the reported cases occurred in patients

**Table 2. PERCENT OF PANCREATIC CANCER CASES BY COMBINED STAGE (pAJCC/cAJCC) AND SELECTED PATIENT, TUMOR, AND REPORTING HOSPITAL CHARACTERISTICS, 1990**

	Stage Group				Total	I/IV Ratio	Cases
	I	II	III	IV			
Diagnosis year							
1983-1985	15.8	9.3	15.2	59.7	100.0	0.26	7767
1990	19.3	9.2	17.2	54.3	100.0	0.36	7059
Total	17.4	9.2	16.2	57.1	100.0	0.31	14826
Age (yr)							
<50	15.0	10.6	17.8	56.6	100.0	0.26	528
50-59	15.7	10.3	20.8	53.2	100.0	0.30	1023
60-69	17.9	9.1	18.2	54.8	100.0	0.33	2220
70-79	19.2	9.0	17.1	54.7	100.0	0.35	2290
80+	28.4	7.9	11.6	52.1	100.0	0.54	998
Sex							
Male	18.0	8.7	17.4	55.9	100.0	0.32	3669
Female	20.7	9.7	17.1	52.5	100.0	0.39	3390
Insurance							
Private	19.0	9.8	18.2	53.1	100.0	0.36	4011
HMO	18.2	9.9	17.0	54.9	100.0	0.33	495
Military/VA	15.7	5.1	19.1	60.2	100.0	0.26	236
Medicare/Medicaid	20.6	8.7	15.5	55.3	100.0	0.37	1773
Other	17.1	7.9	23.7	51.3	100.0	0.33	76
None	17.2	7.3	16.9	58.6	100.0	0.29	261
Unknown	24.2	7.7	10.6	57.5	100.0	0.42	207
Reporting hospital annual caseload							
<150 cases	15.1	3.8	9.4	71.7	100.0	0.21	53
150-499 cases	17.7	7.1	15.9	59.3	100.0	0.30	1287
500-999 cases	19.4	8.8	17.9	53.9	100.0	0.36	2632
1000+ cases	20.6	11.3	17.4	50.7	100.0	0.41	2316
Unknown site	17.8	7.9	17.4	56.9	100.0	0.31	771
Anatomic subsite							
Head	24.7	10.0	22.5	42.8	100.0	0.58	4157
Body	15.3	11.0	12.1	61.6	100.0	0.25	645
Tail	9.0	5.5	5.9	79.6	100.0	0.11	622
Other	36.5	13.5	15.4	34.6	100.0	1.06	60
Overlapping lesion	10.4	11.8	14.8	63.0	100.0	0.16	473
Pancreas, NOS	10.0	5.6	8.0	76.4	100.0	0.13	1102
Total	19.3	9.2	17.2	54.3	100.0	0.36	7059
Grade							
1	27.7	12.8	23.4	36.1	100.0	0.77	640
2	23.6	9.9	24.0	42.4	100.0	0.56	1529
3	15.6	8.3	17.5	58.6	100.0	0.27	1711
4	11.6	5.5	11.6	71.2	100.0	0.16	146
Unknown	17.8	8.7	12.7	60.9	100.0	0.29	3033
Smoking history, males							
Yes	16.8	8.9	18.1	56.2	100.0	0.30	2335
Never	20.1	9.0	18.0	53.0	100.0	0.38	902
Unknown	19.9	7.4	12.3	60.4	100.0	0.33	432
Smoking history, females							
Yes	18.9	9.4	18.2	53.5	100.0	0.35	1283
Never	21.7	10.1	17.0	51.2	100.0	0.42	1578
Unknown	22.3	8.9	14.6	54.3	100.0	0.41	529
Body mass, males (kg)							
<17	10.2	8.2	12.2	69.4	100.0	0.15	56
17.0-20.9	15.1	9.6	15.3	60.0	100.0	0.25	425
21-23.9	19.0	8.7	17.9	54.3	100.0	0.35	709
24.0-26.9	20.8	8.1	19.3	51.8	100.0	0.40	745
27+	15.6	9.3	20.0	55.1	100.0	0.28	719
Unknown	18.4	8.5	14.9	58.2	100.0	0.32	1015
Body mass, females (kg)							
<17	16.9	6.5	14.3	62.3	100.0	0.27	85
17.0-20.9	21.2	9.5	18.1	51.3	100.0	0.41	548
21-23.9	19.9	10.1	20.3	49.7	100.0	0.40	597
24.0-26.9	22.6	11.7	16.6	49.1	100.0	0.46	487
27+	19.8	9.2	19.4	51.7	100.0	0.38	687
Unknown	21.1	9.1	13.2	56.6	100.0	0.37	986

NOS = not otherwise specified.

\* Cases with unknown AJCC stage have been omitted.

**Table 3. PERCENT OF PANCREATIC CANCER CASES BY OTHER SURGICAL EVENTS**

	1983-1985	1990
Bypass operation		
Cholecystojejunostomy	20.2	15.1
Choledocjejunostomy	17.9	18.2
Gastrojejunostomy	29.0	27.5
Other surgical		
Pylorus reconstruction	1.0	2.1
Vagotomy	2.3	2.1
Vascular reconstruction	1.5	1.7
Margins clear	5.6	8.3
Regional nodes examined	10.8	15.0
Surgical complications		
Biliary fistula	0.6	0.3
Gastric obstruction	1.2	1.4
Hemorrhage	1.0	1.4
Pancreatic fistula	0.5	0.5
Prolonged ileus	0.7	1.0
Sepsis	1.2	1.3
Pulmonary embolus	0.3	0.2
Operative death	1.5	1.2

Totals: 1983-1985, 8917 cases; 1990, 8025 cases.

60 years of age and older. The male-to-female ratio for both study years was approximately 1:1 (in 1990, 51.3% were male and 48.7% were female). No patterns of variation were noted among geographic regions of the country. The ethnic mix of pancreatic cancer closely paralleled the U.S. population, based on 1990 census data. Eighty-four percent were non-Hispanic white, and the frequencies for blacks ranged from 9.7% in 1985 to 11.1% in 1990. Evaluation of health insurance informa-

tion showed a very low proportion of patients without coverage (3.7%).

Twelve percent of the patients with pancreatic cancer reported a history of "other cancer"; however, only 3% reported a family history of pancreatic cancer. The smoking history indicated that for both males and females, the reported smoking rates were higher than published averages for the U.S. population, with males ranging from 58% to 63% and females from 36% to 37% across the study periods.<sup>12</sup>

## Symptoms

The most frequent symptom reported was abdominal pain (67%), followed by weight loss greater than 10 lbs (56%), jaundice (45%), back pain (26%), vomiting (24%), indigestion (19%), pruritus (12%), and diabetes mellitus (8%). There were no differences between the first and second study periods in frequency of these symptoms.

## Diagnostic Workup

The initial diagnostic procedures are summarized in Table 1 by frequency of use and frequency of positive results. Tests decreasing in use between 1983 to 1985 and 1990 included liver scans, percutaneous transhepatic cholangiograms, and upper gastrointestinal series. The use of endoscopic retrograde cholangiopancreatography showed an increase between these years, as did abdominal computed tomography scans, preoperative carcinoembryonic antigen, and CA 19-9.

Those tests that demonstrated a trend toward being more predictive of cancer diagnosis included abdominal computed tomography scan (sensitivity = 87%),

**Table 4. PERCENT OF PANCREATIC CANCER CASES BY SURGERY AND AJCC STAGE, AND SELECTED PATIENT, TUMOR, AND REPORTING HOSPITAL CHARACTERISTICS**

Diagnosis Year	Stage	No Cancer Directed	Cancer Directed	Unknown	Total	Cases
1983-1985	I	69.0	29.7	1.3	100.0	1224
1990	I	68.3	30.7	1.0	100.0	1361
1983-1985	II	86.9	11.5	1.5	100.0	719
1990	II	86.9	11.9	1.2	100.0	648
1983-1985	III	69.1	30.0	0.9	100.0	1184
1990	III	61.1	38.1	0.7	100.0	1217
1983-1985	IV	94.6	4.6	0.9	100.0	4640
1990	IV	93.9	5.2	0.9	100.0	3833
1983-1985	Unknown	93.9	4.1	2.0	100.0	1150
1990	Unknown	92.8	4.3	2.9	100.0	966
1983-1985	Total	87.0	11.9	1.1	100.0	8917
1990	Total	83.9	15.0	1.1	100.0	8025

**Table 5. PERCENT OF PANCREATIC CANCER CASES BY SURGERY AND SELECTED TUMOR, PATIENT, AND REPORTING HOSPITAL CHARACTERISTICS, 1990**

	Stage	No Cancer Directed	Cancer Directed	Unknown	Total	Cases
<b>Subsite</b>						
Head	Total	80.7	18.1	1.2	100.0	4757
Body	Total	88.3	10.6	1.1	100.0	720
Tail	Total	81.2	18.8	0.0	100.0	660
Other	Total	60.3	37.9	1.7	100.0	66
Overlapping lesion	Total	92.7	6.9	0.4	100.0	507
Pancreas, NOS	Total	91.9	6.3	1.8	100.0	1314
<b>Age (yr)</b>						
<50	Total	76.7	21.7	1.6	100.0	563
50-59	Total	78.8	19.9	1.3	100.0	1093
60-69	Total	82.3	16.6	1.1	100.0	2462
70-79	Total	85.6	13.5	1.0	100.0	2638
80+	Total	91.1	7.7	1.2	100.0	1269
<b>Sex</b>						
Male	Total	84.3	14.5	1.2	100.0	4115
Female	Total	83.5	15.5	1.0	100.0	3910
<b>Ethnicity</b>						
Non-Hispanic white	Total	83.7	15.3	1.0	100.0	6641
Hispanic	Total	79.0	18.3	2.8	100.0	290
Black	Total	85.9	12.4	1.7	100.0	892
Asian	Total	88.3	11.7	0.0	100.0	103
Unknown	Total	88.9	11.1	0.0	100.0	99
<b>Income</b>						
1 (lowest 20%)	Total	86.5	12.6	1.0	100.0	1854
2 (middle 60%)	Total	83.5	15.4	1.1	100.0	4238
3 (highest 20%)	Total	81.6	17.2	1.2	100.0	1398
Unknown	Total	84.1	14.2	1.7	100.0	535
<b>Insurance</b>						
Private	Total	83.4	15.8	0.8	100.0	4481
HMO	Total	82.6	16.8	0.5	100.0	559
Military/VA	Total	76.4	17.8	5.8	100.0	276
Medicare/Medicaid	Total	87.3	11.7	1.0	100.0	2086
None	Total	81.0	15.3	3.7	100.0	300
Unknown	Total	82.3	16.0	1.6	100.0	243
<b>Reporting hospital's annual pancreas caseload</b>						
<5 cases	Total	84.4	14.5	1.1	100.0	719
6-9 cases	Total	84.5	14.5	1.0	100.0	1101
10-20 cases	Total	84.2	15.1	0.7	100.0	2441
>20 cases	Total	82.6	17.1	0.3	100.0	1384
Unknown size	Total	83.8	13.9	2.2	100.0	2380
<b>Approval category</b>						
Teaching hospital	Total	79.3	19.1	1.5	100.0	2149
Community-comprehensive	Total	84.7	14.5	0.8	100.0	2612
Community	Total	87.2	11.9	0.9	100.0	2327
Other approved	Total	81.5	18.5	0.0	100.0	130
Nonapproved	Total	84.1	13.8	2.1	100.0	807

NOS = not otherwise specified.

Surgery was classified using Data Acquisition Manual codes as follows: no cancer directed, 0-8; local or partial excision of pancreas, 10-19; pancreatectomy, 20-59; other surgery, 80-99; unknown, 9.

endoscopic retrograde cholangiopancreatography (72%), percutaneous transhepatic cholangiograms (66%), abdominal ultrasound (65%), and laparoscopy (60%).

### American Joint Commission on Cancer Stage Grouping

In 1990, 19.3% of all staged cases were stage I, 9.2% were stage II, 17.2% were stage III, and 54.3% were stage

**Table 6. OPERATIVE DEATHS BY AJCC STAGE AND DIAGNOSTIC YEAR FOR PANCREATIC CANCER CASES RECEIVING CANCER-DIRECTED SURGERY**

	I	II	III	IV	Unknown	Total	Cases
Diagnosis year							
1983–1985	7.7	7.2	9.6	11.8	2.1	8.9	1061
1990	7.7	6.5	4.1	6.5	2.4	5.8	1202
Total	7.7	6.9	6.5	9.2	2.2	7.2	2263
Age (1990) (yr)							
<50	3.8	0.0	2.6	0.0	0.0	2.5	122
50–59	2.5	7.7	2.2	6.1	0.0	3.2	218
60–69	7.7	8.0	3.6	5.0	0.0	5.4	409
70–79	9.4	8.7	6.7	4.8	7.1	7.3	355
80+	18.4	0.0	0.0	17.9	0.0	12.2	98
Insurance (1990) (yr)							
Private	8.5	5.7	3.5	7.6	0.0	5.9	706
HMO	5.1	0.0	6.1	21.4	0.0	7.4	94
Military/VA	0.0	0.0	0.0	14.3	0.0	2.0	49
Medicare/Medicaid	8.3	7.1	6.3	2.0	7.7	6.1	244
Other	0.0	0.0	0.0	0.0	0.0	0.0	24
None	15.0	50.0	6.7	0.0	0.0	10.9	46
Unknown	0.0	0.0	0.0	0.0	0.0	0.0	39
Reporting hospital annual pancreatic cancer caseload (1990)							
<5 cases	8.3	12.5	5.4	10.5	0.0	7.7	104
6–9 cases	1.9	40.0	2.9	10.3	16.7	5.6	160
10–20 cases	9.2	4.0	5.5	1.8	0.0	6.0	369
>20 cases	5.6	0.0	2.3	7.5	0.0	4.2	237
Unknown site	10.0	4.3	4.0	7.0	0.0	6.3	332
Hospital approval category (1990)							
Teaching hospital	6.3	9.1	3.0	4.5	0.0	4.6	411
Community-comprehensive	7.2	4.3	4.1	1.7	0.0	4.7	379
Community	7.4	10.5	6.6	10.2	11.1	7.9	277
Other approved	33.3	0.0	6.7	0.0	0.0	12.5	24
Nonapproved	11.1	0.0	0.0	15.4	0.0	7.2	111
Referral class (1990)							
Diagnosed here	7.2	7.4	4.5	7.1	2.9	6.0	1062
Diagnosed elsewhere	12.2	0.0	1.6	0.0	0.0	4.3	140

IV. In the years from 1983 to 1985, 15.8% of all staged cases were stage I, 9.3% were stage II, 15.2% were stage III, and 59.7% were stage IV (Table 2). The ratio of early disease (stage I) to late disease (stage IV) improved from 0.26 in 1985 to 0.36 in 1990.

There was a strong relationship between stage and both anatomic subsite and histologic grade. More stage IV disease (79.6%) was reported for cancers of the tail of the pancreas and for grade IV (71.2%) as compared with grade I (36.1%).

## Surgery

The use of palliative treatment (including cholecystojejunostomy, choledochojejunostomy, and gastrojejunostomy) did not change during the study period (Table 3). Gastrojejunostomy (27.5% of all cases in 1990) was the most frequent bypass operation reported.

For 1990, 30.7% of the patients undergoing cancer-directed surgery reported were stage I, 11.9% were stage II, 38.1% were stage III, and 5.2% were stage IV. The percentage of cancer-directed resections varied widely by stage (Tables 4 and 5). The type of surgery reported varied markedly, as did corresponding patient and reporting hospital characteristics.

In 1990, older patients were less likely to receive cancer-directed surgery (13.5% for those 70–79 years of age vs. 21.7% for those younger than 50 years of age). Cancer-directed surgery rates were lowest for blacks (12.4%) and Asians (11.7%), compared with non-Hispanic whites (15%) and Hispanics (18.3%). Patients from low income neighborhoods were less likely to have received cancer-directed surgery (12.6%) than those from middle-income (15.4%) and high-income neighborhoods (17.2%). Although the stage distribution was similar among income groups, patients reported as having Medicare/Medicaid insurance coverage were less likely to have received can-

**Table 7. PERCENT OF PANCREATIC CANCER CASES BY TREATMENT COMBINATION AND SELECTED PATIENT, TUMOR, AND REPORTING HOSPITAL CHARACTERISTICS**

Diagnosis Year	Stage	Cancer Directed			Radiation and Chemo	Surgery and Radiation and Chemo	Other	No Cancer Directed	Total	Cases
		Surgery	Radiation	Chemo	Chemo					
1983-1985	I	24.0	10.7	5.0	15.1	2.0	3.8	39.5	100.0	1224
1983-1985	II	8.1	11.0	8.6	26.8	1.8	1.7	42.0	100.0	719
1983-1985	III	21.6	8.0	9.5	16.7	3.3	5.1	35.7	100.0	1184
1983-1985	IV	2.5	5.8	25.3	8.4	0.5	1.6	56.0	100.0	4640
1983-1985	Unknown	2.7	7.4	11.0	15.0	0.7	0.7	62.5	100.0	1150
1983-1985	Total	8.5	7.4	17.2	12.8	1.2	2.3	50.7	100.0	8917
1990	I	21.3	6.3	4.0	21.7	7.1	2.4	37.3	100.0	1361
1990	II	7.4	5.6	9.4	37.8	3.2	1.2	35.3	100.0	648
1990	III	19.6	4.7	6.3	23.3	14.3	4.2	27.5	100.0	1217
1990	IV	3.4	4.5	25.8	10.5	0.5	1.3	54.0	100.0	3833
1990	Unknown	2.5	6.9	7.0	15.8	0.7	1.1	65.8	100.0	966
1990	Total	9.1	5.2	15.6	17.2	4.0	1.9	47.1	100.0	8025
Total	I	22.6	8.4	4.4	18.6	4.6	3.0	38.3	100.0	2585
Total	II	7.8	8.4	9.0	32.0	2.5	1.5	38.8	100.0	1367
Total	III	20.6	6.3	7.9	20.1	8.9	4.6	31.6	100.0	2401
Total	IV	2.9	5.2	25.5	9.3	0.5	1.5	55.1	100.0	8473
Total	Unknown	2.6	7.2	9.2	15.4	0.7	0.9	64.0	100.0	2116
Total	Total	8.8	6.4	16.4	14.9	2.5	2.1	49.0	100.0	16942
Age (1990) (yr)										
	<50	10.5	3.9	25.2	19.7	7.1	4.1	29.5	100.0	563
	50-59	10.2	4.8	19.9	23.7	6.3	3.5	31.6	100.0	1093
	60-69	9.5	5.6	18.7	20.0	5.2	1.9	39.0	100.0	2462
	70-79	9.1	5.8	13.5	16.0	2.8	1.5	51.3	100.0	2638
	80+	7.0	4.1	5.7	7.4	0.3	0.4	75.1	100.0	1269
Sex (1990)										
	Male	8.4	5.7	17.4	17.8	4.1	2.0	44.6	100.0	4115
	Female	9.9	4.7	13.6	16.5	3.8	1.8	49.7	100.0	3910
Ethnicity (1990)										
	Non-Hispanic white	9.3	5.2	15.9	17.5	4.1	1.9	46.1	100.0	6641
	Hispanic	9.7	4.5	12.8	12.8	5.2	3.4	51.7	100.0	290
	Black	8.2	4.4	13.8	16.5	2.6	1.7	52.9	100.0	892
	Asian	6.8	11.7	17.5	17.5	3.9	1.0	41.7	100.0	103
	Unknown	9.1	6.1	13.1	14.1	2.0	0.0	55.6	100.0	99
Income (1990)										
	1 (lowest 20%)	7.1	5.2	13.2	17.1	3.5	2.0	51.9	100.0	1854
	2 (middle 60%)	9.7	5.4	16.1	16.8	3.8	1.8	46.3	100.0	4238
	3 (highest 20%)	10.0	4.9	17.5	18.2	5.3	1.9	42.2	100.0	1398
	Unknown	9.2	4.5	13.8	18.1	3.0	2.1	49.3	100.0	535
Insurance (1990)										
	Private	8.9	5.3	17.7	19.3	4.6	2.2	41.8	100.0	4481
	HMO	10.4	7.2	15.6	12.9	4.3	2.1	47.6	100.0	559
	Military/VA	11.6	4.0	13.0	12.0	4.3	1.8	53.3	100.0	276
	Medicare/Medicaid	8.0	4.7	11.9	14.3	2.3	1.4	57.4	100.0	2086
	Other	20.0	0.0	16.3	25.0	7.5	2.5	28.8	100.0	80
	None	10.0	5.0	12.0	15.7	4.3	1.0	52.0	100.0	300
	Unknown	12.3	6.6	14.0	16.5	2.9	0.8	46.9	100.0	243
Hospital caseload (1990)										
	<150 cases	10.3	5.2	20.7	12.1	0.0	1.7	50.0	100.0	58
	150-499 cases	8.1	5.1	14.2	13.2	2.9	1.4	55.0	100.0	1468
	500-999 cases	7.7	6.2	15.7	19.0	3.6	1.9	45.9	100.0	3029
	1000+ cases	10.5	4.4	16.7	18.8	5.1	2.1	42.5	100.0	2569
	Unknown size	11.9	4.6	13.5	13.0	3.9	2.1	51.1	100.0	901

(continues)



**Table 7 (continued). PERCENT OF PANCREATIC CANCER CASES BY TREATMENT COMBINATION AND SELECTED PATIENT, TUMOR, AND REPORTING HOSPITAL CHARACTERISTICS**

Diagnosis Year	Stage	Cancer Directed Surgery	Radiation	Chemo	Radiation and Chemo	Surgery and Radiation and Chemo	Other	No Cancer Directed	Total	Cases
Approval category (type of hospital) (1990)										
	Teaching hospital	12.1	4.9	15.1	15.7	4.6	2.4	45.2	100.0	2149
	Community-comprehensive	8.7	6.1	16.2	18.2	3.9	1.8	44.9	100.0	2612
	Community	6.7	4.9	15.0	18.4	3.7	1.6	49.7	100.0	2327
	Other approved	11.5	2.3	22.3	14.6	6.2	0.8	42.3	100.0	130
	Nonapproved	9.2	4.3	15.0	14.7	2.9	1.7	52.2	100.0	807
Referral class (1990)										
	Diagnosed here	9.8	4.6	15.0	13.8	3.5	1.9	51.3	100.0	6974
	Diagnosed elsewhere	4.6	9.1	19.1	39.3	6.7	2.1	19.1	100.0	1051
Subsite (1990)										
	Head	11.0	5.3	11.8	18.0	6.2	1.8	46.8	100.0	4757
	Body	6.0	6.0	20.7	21.5	2.8	1.8	41.3	100.0	720
	Tail	10.9	3.3	25.0	9.7	3.5	4.4	43.2	100.0	660
	Other	20.7	3.4	5.2	15.5	12.1	5.2	37.9	100.0	67
	Overlapping lesion	4.5	6.3	17.9	22.7	1.4	1.0	46.2	100.0	507
	Pancreas, NOS	4.4	5.1	21.0	13.5	0.8	1.1	54.0	100.0	1314
Grade (1990)										
	1	14.8	5.3	11.8	18.0	7.9	2.9	39.2	100.0	694
	2	15.3	4.4	12.2	18.9	7.2	3.2	38.6	100.0	1669
	3	10.0	4.4	18.7	15.3	4.0	1.9	45.7	100.0	1865
	4	4.0	4.6	20.5	13.2	2.6	2.6	52.3	100.0	151
	Unknown	5.0	6.0	16.0	17.3	1.7	1.1	52.9	100.0	3646
Body mass, males (1990) (kg)										
	<17	4.8	1.6	11.3	17.7	0.0	3.2	61.3	100.0	69
	17.0-20.9	9.9	6.1	18.4	14.6	2.3	1.1	47.6	100.0	473
	21-23.9	7.8	5.3	18.7	17.2	3.5	1.9	45.5	100.0	791
	24.0-26.9	7.9	4.4	17.0	20.7	5.9	2.7	41.5	100.0	813
	27+	10.9	5.3	21.9	17.5	5.0	2.8	36.6	100.0	777
	Unknown	7.2	7.0	13.8	17.7	3.6	1.2	49.4	100.0	1192
Body mass, females (1990) (kg)										
	<17	8.9	3.3	10.0	20.0	1.1	2.2	54.4	100.0	100
	17.0-20.9	10.7	4.3	13.2	14.5	4.0	1.7	51.7	100.0	629
	21-23.9	10.1	5.0	13.1	17.4	4.4	2.3	47.7	100.0	662
	24.0-26.9	11.9	4.2	17.1	15.8	4.0	1.7	45.3	100.0	545
	27+	12.4	3.0	16.8	19.9	4.2	1.7	42.0	100.0	758
	Unknown	6.9	6.3	10.9	14.9	3.2	1.7	56.1	100.0	1216

Chemo = chemotherapy; NOS = not otherwise specified.

cer-directed surgery (11.7%) than those with private insurance (15.8%).

Patients seen at institutions with larger pancreatic cancer caseloads (20 or more cases per year) were more likely to have received cancer-directed surgery (17.1%) than those seen at institutions treating less than 5 cases per year (14.5%). Also, curative procedures (cancer-directed operations) were performed more often in teaching institutions (19.2%) versus community hospital comprehensive institutions (14.5%). The percentage of reported surgical complications was equivalent in both reporting periods. The most frequent complications reported in 1990 were gastric obstruction (1.4%) and hemorrhage (1.4%).

There were 163 operative deaths reported among the 2263 resections performed (Table 6). Although interpretation of this number of deaths by subgroup yields modest or small numbers in each strata, some inferences can be made. There was a marked decrease in the percentage of operative deaths reported, from 8.9% for those diagnosed from 1983 to 1985 to 5.8% for those diagnosed in 1990. Patient age and insurance coverage also are shown to affect outcome. The percentage of operative deaths increased with age, with 2.5% operative mortality in the patient 50 years of age and younger, gradually increasing to 12.2% in those 80 years of age and older. Patients with private insurance had an overall 5.9% mortal-

ity rate *versus* 10.9% for those without insurance. This phenomenon is perhaps related to a diversity in socioeconomic status and lack of standard preventive health care. There was no apparent relationship between operative mortality and sex and urban/rural residence. Subgroups of interest by region and ethnicity were too small for analysis.

The data contained in Table 6 also suggest that place of patient treatment makes a difference in operative outcome. Operative mortality decreased as the number of annual pancreatic cancers managed in a given institution increased. There was a 7.7% operative mortality when less than 5 patients were seen per year and a 4.2% operative mortality when 20 or more patients were managed per year. The community comprehensive hospitals and teaching hospitals showed an operative mortality rate of 4.6% and 4.7%, respectively, whereas the community hospitals and hospitals without commission approval status had an operative mortality rate slightly greater than 7%. Patients first diagnosed at one hospital and then referred elsewhere had a 4.3% operative mortality compared with a 6.0% for patients who were not referred from hospital to hospital.

### Multimodality Treatment

In 1990, 9.1% of the patients studied were reported to have received cancer-directed surgery only, 5.2% were reported to have received radiation only, 15.6% were reported to have received chemotherapy only, 17.2% were reported to have received radiation combined with chemotherapy, and 4.0% were reported to have received received surgery, radiation, and chemotherapy combined (Table 7). The use of chemotherapy rose from 31.2% to 36.8%, and radiation therapy rose from 21.4% to 26.4% between 1983 and 1985 and 1990, respectively. Ninety-seven percent of radiation therapy administered was external beam.

The patterns of multimodality treatment were influenced strongly by patient characteristics, insurance coverage, and reporting institution. A decreasing percentage of patients received multimodality therapy (surgery and/or radiation and/or chemotherapy) with advancing age. Only 29.5% of patients younger than 50 years of age received no cancer-directed therapy, compared with 51.3% aged 70 to 79 years, and 75.1% who were 80 years of age or older. A somewhat higher percentage of females (49.7%) received cancer-directed treatment compared with males (44.6%). Larger percentages of blacks (52.9%) and Hispanics (51.7%) received no cancer-directed treatment compared with Asians (41.7%) and non-Hispanic whites (46.1%). Compared with those covered by private insurance (41.8%), patient groups that reported higher

percentages of no cancer-directed therapy included those covered by Medicare/Medicaid (57.4%), those with military/Veterans Administration coverage (53.3%), and those reported to be without coverage (52.0%). Patients from the lowest income group were reported with 51.9% receiving no cancer-directed surgery, compared with those of middle income (46.3%), and higher income (42.2%).

At smaller hospitals (*i.e.*, 150–400 total cases per year), 55.0% of the patients received no cancer-directed therapy compared with 42.5% at hospitals with annual total cancer caseloads exceeding 1000. Teaching hospitals and community comprehensive centers reported 45.2% and 44.9% of patients received no cancer-directed therapy, respectively, compared with higher percentages of untreated patients at community hospitals (49.7%) and at hospitals without Commission on Cancer approval status (52.2%).

### Survival

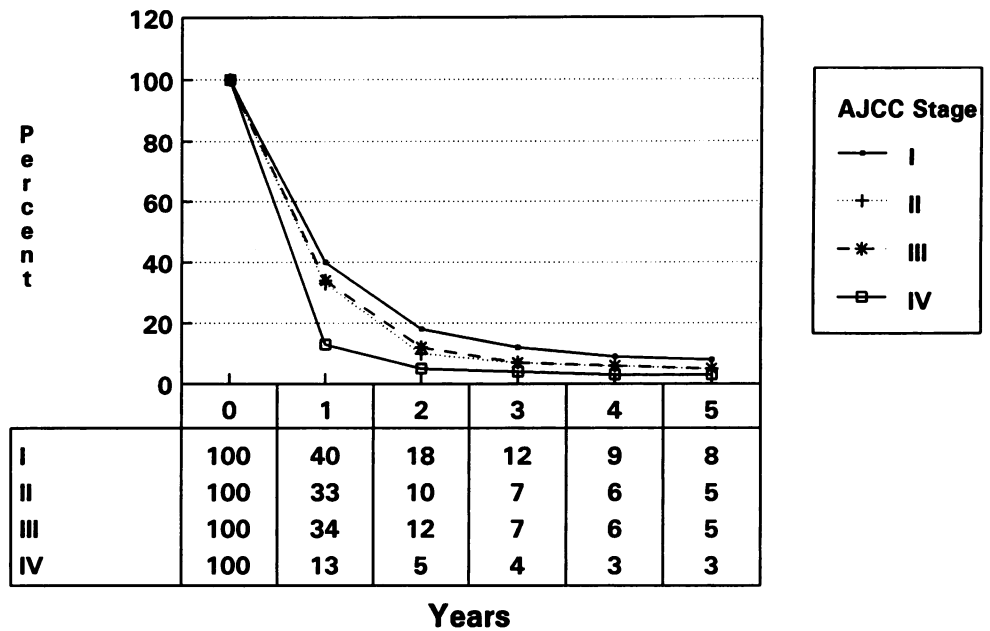
The 2-year relative survival rate for pancreatic cancer for patients diagnosed from 1983 to 1985 was 18% for stage I, 10% for stage II, 12% for stage III, and 5% for stage IV (Fig. 1). The overall 5-year survival for study period 1983 to 1985 was uniformly poor, varying from 8% for stage I to 3% for stage IV. For stage I cases, there was better survival reported in the younger age groups (<60 years), with a 50% 2-year survival rate compared with 31% in the oldest group.

The 2-year survival for patients receiving only cancer-directed surgery only was 35% contrasted with 13% for radiation and chemotherapy combined, 12% for no cancer-directed treatment, 9% for chemotherapy only, and 6% for radiation only (Fig. 2). For stage II cancers, the 58 patients who had cancer-directed surgery only had a 2-year survival of 35% compared with less than 10% for other treatment options. This is probably due largely to a function of stage, because earlier staged cases were more likely to receive cancer-directed surgery. It should be remembered that these patients were not randomized into treatment groups and are not stratified by age or other prognostic factors; these results are described to record survival experience and do not imply that statistical comparisons are appropriate.

### DISCUSSION

Adenocarcinoma of the pancreas continues to be primarily a disease of older patients with 78% of patients 60 years of age and older. These data, in contrast to frequently quoted statistics, have a male-to-female ratio of nearly 1:1 rather than a stronger male preponderance. However, although it may be that females are more at

**Figure 1.** Relative 5-year pancreatic cancer survival rate by combined stage (pAJCC/cAJCC), 1983-1985.



risk for this disease than previously suspected, it also is true that there are simply more of them in the age ranges in which this cancer is diagnosed most frequently.

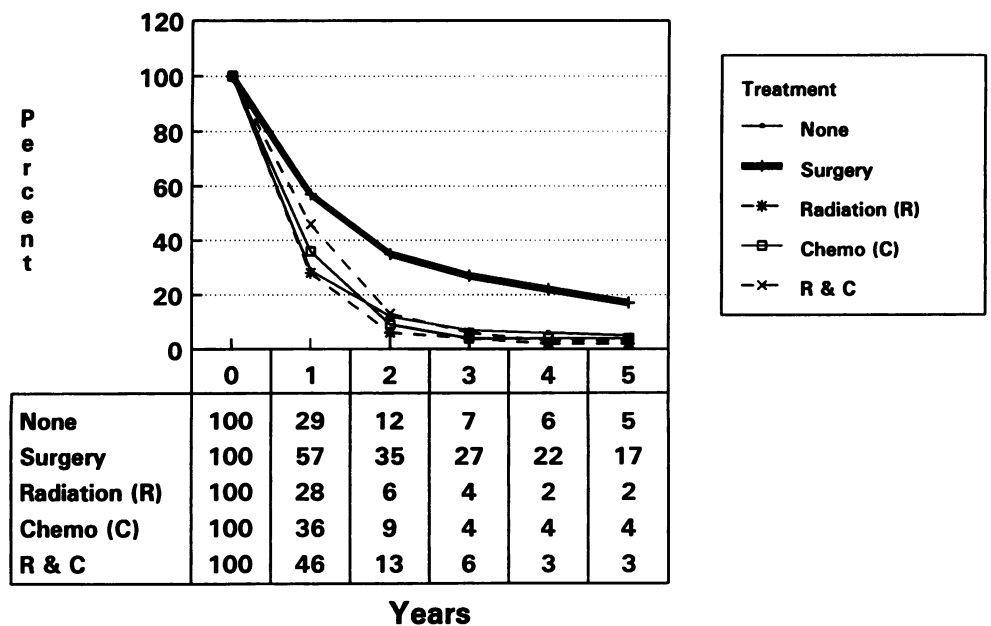
Smoking rates for both males and females exceeded the quoted smoking rates for similar age groups in the U.S. population,<sup>12</sup> consistent with a causal hypothesis for tobacco consumption and pancreatic oncogenesis.

There was a trend toward increased use of the abdominal computed tomography scan, endoscopic retrograde cholangiopancreatography, and CA 19-9 for diagnostic preoperative workup. The accuracy of these tests in de-

tecting pancreatic cancer also seemed to increase over the study period. The use of upper gastrointestinal series, liver scans, and percutaneous transhepatic cholangiograms decreased somewhat across these same years.

The study was limited to adenocarcinoma of the pancreas. The pancreatic head continued to be the most frequent site (58% of all cases). Thirteen percent of the patients had histologic confirmation preoperatively. The slight down-staging between 1983 to 1985 and 1990 was not substantial, and 25% continued to have no stage reported.

**Figure 2.** Relative 5-year pancreatic cancer survival rate by treatment, 1983-1985.



Surgical attempts at cure (*i.e.*, cancer-directed surgery) increased slightly, from 10% to 13% between 1983 to 1985 and 1990. These numbers primarily reflected increase in the use of the Whipple procedure. Twelve percent of resections were pylorus-sparing. Surgical treatment complications, primarily sepsis and hemorrhage, remained virtually the same between 1983 to 1985 and 1990. Operative mortality from cancer-directed surgery decreased from 7.4% to 5% between 1983 to 1985 and 1990. Operative mortality from cancer-directed surgery was 4.2% for hospitals treating more than 20 pancreatic cases per year, compared with 6% for hospitals treating 11 to 20 cases, 5.6% for 6 to 10 cases, and 7.7% for 5 cases or less.

Parameters associated with increased prolonged overall survival were small tumor size, earlier AJCC stage, and more differentiated tumor grade. There was no apparent association between survival and multiple transfusions, abnormal computed tomography scan results, smoking history, or numbers of positive nodes in patients receiving cancer-directed surgery.

Overall, 5-year survival for patients diagnosed from 1983 to 1985 was 2.2%. For patients who had cancer-directed surgery, the survival was between 3% and 4% for all stages combined. However, stage I patients were observed to have a 15% 5-year survival with cancer-directed surgery; without cancer-directed surgery, survival was only 4%. Eighteen percent of stage II patients with cancer-directed surgery (only 60 patients) survived 5 years *versus* 3% rate without cancer-directed surgery. The restriction of this study to adenocarcinoma of the pancreas excludes the more favorable periaampullary tumors that tend to have higher 5-year survival rates. These tumors often are included in reports of survival after pancreaticoduodenectomy.

For highly selected patients, cancer-directed surgery offers the best chance for cure (albeit small), with a reasonable operative mortality and complication rate in certain institutions. However, despite more sophisticated testing during this study period, there is minimal, if any,

improvement toward earlier diagnosis, down-staging, and 5-year survival. Many changes are occurring in the methods used to establish diagnosis and select patients for surgery. Currently, patients are taken less often to surgery for exploration and simple palliation by biliary decompression. Patients deemed unresectable by preoperative staging generally can be spared surgery. However, there is a trend among surgeons toward the use of pancreaticoduodenectomy as a palliative procedure because of the markedly improved safety of this operation. From these data, it appears that the diagnosis and management of this cancer is continuing to evolve. It is likely that these shifts will be reflected in marked changes in survival in subsequent surveys.

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