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ORIGINAL RESEARCH

Outcomes After Multimodality Treatment of Pancreatic Cancer in an Unselected Single-Center Cohort

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Background: Pancreatic ductal adenocarcinoma (PDAC) remains a lethal and rarely resectable malignancy. Here we explore the outcomes of surgery, as compared to definitive radiotherapy (dRT) or systemic therapy only in PDAC.

Methods: Pancreatic surgery and radiotherapy in Southwest Finland have been centralized to Turku University Hospital. Previously validated population-based electronic health records database was searched for all unselected PDAC patients from the years 2009–2019. Main outcome was median overall survival (mOS). Demographics, pathology, surgery, and oncological treatment data were collected.

Results: We identified 1006 patients with PDAC, 49% male, median age 71 years and 77% presenting with metastatic disease. In total, 405 patients were treated; 92 resected, 26 dRT without resection and 287 systemic therapy only. mOS was 34.6 months for resected, 26.7 months for dRT, and 7.5 months for systemic therapy patients. Among the 88 patients with locally advanced inoperable PDAC, dRT was independently associated with longer mOS (26.7 months) as compared to systemic therapy only (mOS 10.6 months). Among the 287 patients treated with systemic therapy only, combination chemotherapy was independently associated with longer mOS (11.6 months) as compared to gemcitabine-monotherapy (6.8 months). In patients progressing to second-line systemic treatment after gemcitabine failure, mOS was the same (5.0 months) with single or combination regimens.

Conclusion: Surgery remains the only curative approach for PDAC. In locally advanced PDAC, dRT was associated with longer survival as compared to systemic therapy only. Concerning first-line systemic therapy, our results support the use of combination chemotherapy over single-agent therapy.

Keywords: pancreatic cancer, pancreas, pancreatectomy, nab-paclitaxel, chemoradiotherapy

Introduction

Pancreatic ductal adenocarcinoma (PDAC) has a rising annual incidence of 4–8 per 100 000 people, affecting men slightly more often than women, at median age of 71 years.[1–3] The selection of patients for surgery of PDAC has improved with the advancements in radiological evaluation of resectability, and centralized pancreatic surgery,[4–6] along with the introduction of pancreatectomy with mesenteric and portal vein resections.[7] To support the decision-making for upfront surgery versus preoperative treatments, the classification of resectable, borderline and locally advanced (LA) PDAC has been introduced, with slightly variable definitions.[1,6,8] Regardless, only 7% of all PDAC patients in Finland were suitable for surgery during years 2002–2008,[9] as compared to 14–23% reported more recently in the Netherlands and the United States.[10,11] Landmark adjuvant trials in resected PDAC include CONKO-001 and ESPAC-4, where median overall survival (mOS) of 23–25 months was reported with gemcitabine-based adjuvant chemotherapy.[12,13] The PRODIGE-24 trial has reported the longest mOS of 54 months with FOLFIRINOX adjuvant chemotherapy.[14]

Concerning borderline resectable PDAC, the discussion is ongoing whether emerging neoadjuvant chemotherapy or chemoradiotherapy (CRT) should be used instead of upfront surgery.[1,6,15] The PREOPANC trial ultimately showed some survival gain in this subgroup with CRT versus upfront surgery, presenting a decreased resection rate due to exclusion of

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rapidly progressing tumors during the neoadjuvant treatment.[16] However, the role of chemotherapy only as a neoadjuvant regimen is yet to be prospectively explored,[1] while encouraging patient series have been published.[17–19]

In LA-PDAC, mOS of 11–16 months with gemcitabine-based CRT has been reported, with post-CRT resection rates of 4–17%.[20,21] However, when surgery cannot be performed, CRT followed by chemotherapy has not been shown to demonstrate any survival advantage over chemotherapy alone, mOS being roughly 19 months.[22–24] A marked heterogeneity exists in the conduct of different CRT techniques, causing pitfalls in the performing of meta-analyses.[22]

The treatment of metastatic PDAC remains challenging. In trials, albumin-bound paclitaxel combined with gemcitabine has prolonged mOS up to 8–9 months, and triplet-regimens up to 11 months.[25–27] Roughly the same mOS has been reported in a large real-world PDAC registry, especially among younger and better performance status patients.[28]

In Finland, nationwide act on the centralization of pancreatic surgery to university hospitals started during 1990s and became fully in effect during 2018.[4] Patients considered for pancreatic surgery are referred to university hospitals, while systemic therapy may be administered at regional hospitals. In the Turku region all treatments are given at Turku University Hospital. No national guidelines exist for PDAC in Finland.

The aim of the current study is to explore survival and baseline demographics in a series of consecutively diagnosed and unselected patients with PDAC according to treatment modality; surgery, definitive radiotherapy (dRT) or systemic therapy only.

Materials and Methods

Ethics Statement

The current study was approved by the Institutional Review Board of Turku University Hospital, Turku, Finland (T132/2019), and conducted in accordance with the Declaration of Helsinki. The Review Board did not require informed consent, reason of waiver being the national legislation allowing register-based studies without informed consent (Finnish Act on Secondary Use of Health and Social Data), since only register-data is used and participants are not contacted. Data was stored locally in a secured analysis environment protected by the Turku University Hospital firewall covering data confidentiality.

Patients

All consecutive patients diagnosed with PDAC (ICD-10 code C25) during 2009–2019 were included as part of our previous study with an almost complete population-based coverage of roughly 480 000 inhabitants.[29] Inclusion flowchart is presented in Figure 1. Duodenal cancer and malignant invasive intraductal papillary mucinous neoplasia were not included.

Clinical Data

Resected patients were identified with Nordic Operational Codes (NOMESCO) JLC** and subsequently manually verified allowing resection margins R0 (radical resection with margins >1mm), R1 (microscopic margin) or R2 (macroscopic residual). All patients with LA-PDAC were manually reviewed to identify patients who underwent explorative laparoscopy/laparotomy without pancreatic surgery. Those not resected but who initiated CRT, conventional definitive radiotherapy or stereotactic body radiotherapy (SBRT) formed the dRT group. Remaining patients treated at least once with systemic therapy formed the systemic therapy cohort and the remaining best supportive care (BSC) cohort. Palliative radiotherapy was not used as a classifier.

Postoperative tumor TNM depending on the version used at that time, resection margin status and Eastern Cooperative Oncology Group (ECOG) performance status were collected as reported in the medical records. Nodal status N2 was defined as ≥4 metastatic lymph nodes. Adjuvant chemotherapy was defined as at least one regimen administered within three months postoperatively. At our hospital, albumin-bound paclitaxel became available during year 2014 and triplet regimen (mFOLFIRINOX) during 2019.

The aim of dRT is to deliver a high biological dose to the pancreatic tumor aiming at long-term remission. The fractionation between CRT and SBRT differs. In SBRT, higher doses per fraction are used and SBRT is delivered without

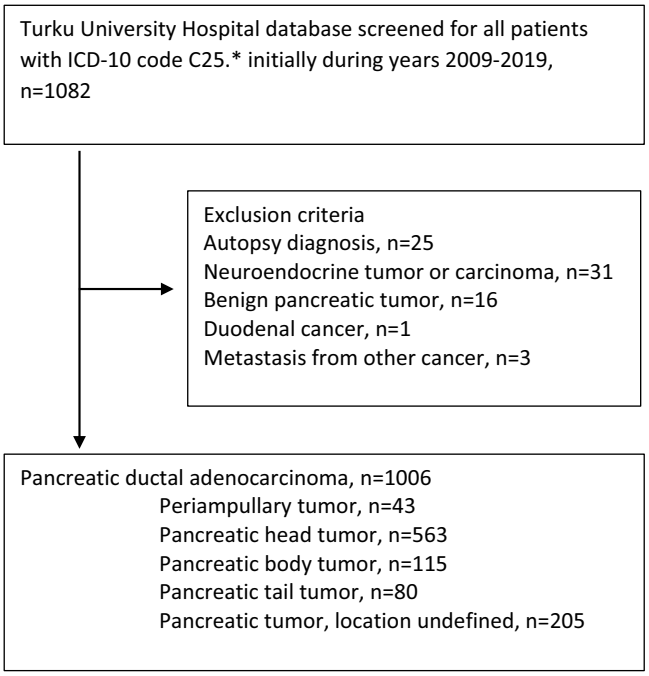

Figure 1 Flowchart of the study population.

chemotherapy. Both techniques may be utilized based on individual's preferences.[30,31] Image guided CRT chemosensitized either with weekly gemcitabine 300mg/m^2 or daily capecitabine 1600mg/m^2 and SBRT were included. Mean tumor dose delivered was 47.4Gy (range 41.4–50.4Gy) in the CRT group and for SBRT 30Gy or 36Gy in six fractions. Radiation planning was performed with 4D contrast enhanced computed tomography images with the help of fused magnetic and positron emission tomography images, using delineation guidelines provided for the primary tumor and regional lymph nodes.[32] In conventionally fractionated therapy, either volumetric modulated arch (n=14) or intensity modulated therapy (n=10) technique was used. Prior to each fraction, kV or cone beam computed tomography imaging was used for matching.

Statistics

The date and cause of death were retrieved until 31.12.2020. Median overall survival (mOS) was defined from PDAC diagnosis to death. Relapse-free survival (RFS) was defined from surgery or start of dRT to PDAC relapse, excluding patients whose follow-up was not in our hospital. For the second-line systemic therapy analysis, median OS^{2ndline} was calculated from the initiation of second-line treatment to death. Survival was calculated with Kaplan–Meier log rank method and hazard ratios (HRs) with Cox multivariable regression model using enter method and 95% confidence intervals (CI). Demographics were compared with chi-square or analysis of variance methods. SPSS version 26 (IBM, Armonk, NY) was used.

Results

Overall Survival and Baseline Demographics

A total of 1006 patients with PDAC were identified during 2009–2019. Median age at diagnosis was 71 (range 26–96) years, 487 (49%) patients were male, 497 (49%) presented with comorbidities and 774 (77%) with metastatic PDAC. ECOG performance status 2 or more was noted in 255/671 (38%) patients. Primary tumor location was pancreatic head (n=563), body (n=115), tail (n=80), periampullary (n=43) or other/undefined (n=205). Six patients had mucinous adenocarcinoma/cystadenocarcinoma. At baseline, liver metastases were present in 62%, peritoneal carcinosis in 18%, lung metastases in 13% and distant lymph nodes in 21% of patients treated with systemic therapy.

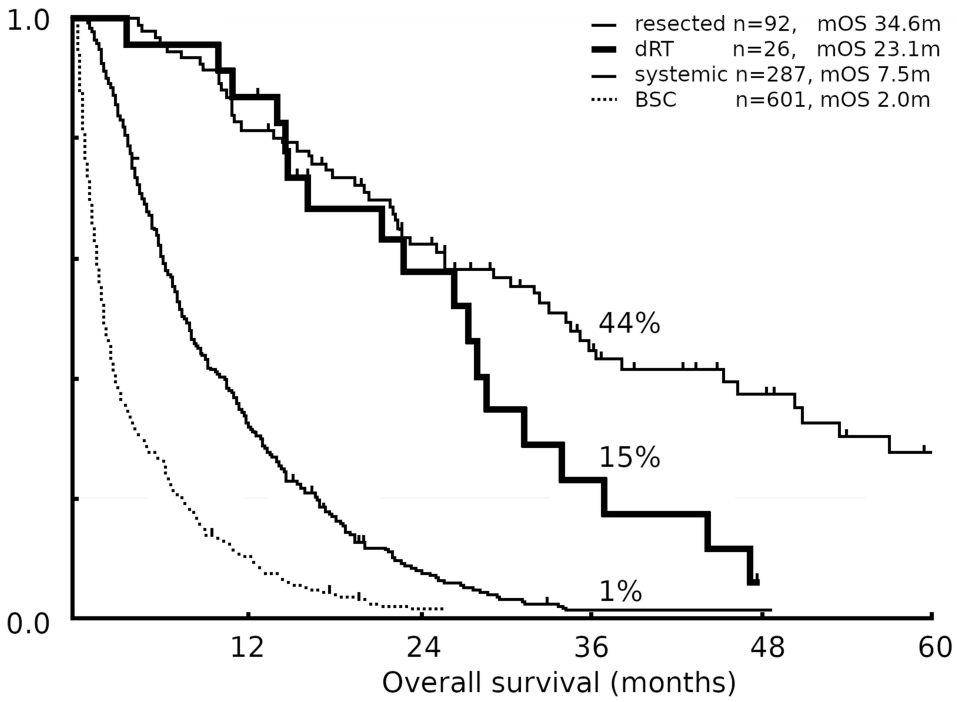

Figure 2 Overall survival in pancreatic cancer.
Abbreviations: dRT, definitive radiotherapy; BSC, best supportive care; mOS, median overall survival.

For all patients, including BSC only, the median follow-up was 4.4 months during which 960 deaths had occurred, and majority (n=952) died due to PDAC. Of the 1006 patients with PDAC, 405 (40%) were treated; 92 resected, 26 received dRT without resection and 287 systemic therapy only. mOS was 34.6 months for resected, 23.1 months for dRT, 7.5 months for systemic therapy, and 2.0 months for BSC patients (Figure 2).

Patient demographics at baseline per treatment modality are shown in Table 1. Among the treated patients, differences were observed in ECOG performance status, Ca19-9 levels and BMI; patients with ECOG performance status 2+ were seldom resected or treated with dRT. Lowest BMI was observed in the dRT group and Ca19-9 antigen was most

Table 1 Baseline Demographics of the Study Population. Statistical Comparison Done Between Treated Patients

Demographics	Resected	dRT	Systemic	p-value	BSC
Patients (n)	92	26	287		601
Mean age (range), years	66 (38–83)	64 (45–86)	66 (32–84)	ns (0.6)	74 (26–96)
Median age (IQR), years	67 (62–72)	64 (58–70)	67 (62–72)		76 (69–83)
Age < 70 years	60 (65%)	20 (77%)	202 (70%)	ns (0.5)	195 (32%)
Sex: Male	52 (57%)	15 (58%)	132 (46%)	ns (0.12)	289 (48%)
Performance status				0.02	
0	9 (12%)	1 (4%)	14 (5%)		6 (2%)
1	62 (83%)	23 (89%)	211 (75%)		90 (31%)
2+	4 (5%)	2 (7%)	57 (21%)		192 (67%)
Missing	17	0	5		313

(*Continued*)

Table 1 (Continued).

Demographics	Resected	dRT	Systemic	p-value	BSC
Comorbidities				ns (0.4)	
Charlson index 0	55 (60%)	13 (50%)	152 (54%)		284 (47%)
Charlson index 1	21 (23%)	10 (39%)	93 (32%)		167 (28%)
Charlson index 2+	16 (17%)	3 (12%)	42 (15%)		150 (25%)
Alcohol abuse (F10)	1 (1%)	0	9 (3%)	ns (0.5)	21 (3%)
Diabetes (E10-14)	21 (23%)	6 (23%)	70 (24%)	ns (0.9)	152 (25%)
Smoking status				ns (0.5)	
Never	32 (41%)	10 (40%)	114 (48%)		171 (44%)
Current/Former	46 (59%)	15 (60%)	150 (52%)		213 (56%)
Missing	14	1	23		217
Mean BMI, kg/m^2	25.8	24.6	25.3	ns (0.4)	26.1
BMI < 21 kg/m^2	9 (10%)	8 (31%)	46 (16%)	0.03	49 (15%)
BMI ≥ 21 kg/m^2	82 (90%)	15 (69%)	239 (84%)		270 (85%)
Missing	0	0	1		282
Laboratory values					
Ca19-9 elevated > 500 kU/l*	9/82 (11%)	9/25 (36%)	151/272 (56%)	<0.001	246/422 (58%)
Bilirubin elevated > ULN	36/88 (41%)	12/25 (48%)	121/276 (44%)	ns (0.8)	309/552 (56%)
Hypoalbuminemia < ULN	30/52 (58%)	2/7 (29%)	68/126 (54%)	ns (0.3)	186/228 (82%)

Notes: *Ca19-9 collected when bilirubin < ULN.
Abbreviations: BSC, best supportive care; dRT, definitive radiotherapy; IQR, interquartile range; ns, non-significant; ULN, upper limit of reference range.

commonly elevated among patients treated with systemic therapy only. No differences in age, sex, comorbidities or smoking status were observed.

Surgery Outcomes

Surgery was considered for 155 patients, of whom five were not suitable for surgery due to comorbidities. Of those, 92/150 (61%) patients were resected (Table 2). 90-day mortality was not observed. Tumor was found inoperable in situ among the remaining 58 patients, of whom 14 were subsequently allocated to dRT and 29 to systemic therapy groups. Neoadjuvant chemotherapy was introduced in 2019, and only three of our patients received it, and none were operated.

For the 92 resected patients, mOS was 34.6 months with 1, 3 and 5-year survival rates of 82%, 44% and 25%, respectively (Figure 2). Median follow-up was 26 months. Median RFS was 15.4 months (n=78) with 1- and 3-year relapse-free rates of 65% and 27%. In total, 11 distal pancreatectomies, 77 pancreaticoduodenectomies and four total pancreatectomies were performed.

Resection margins, nodal status and tumor location were associated with surgical outcomes (Table 2). R0-resection was performed in 73 patients (79%) with mOS of 45.8 months, as compared to 20.3 months after R1- or 10.3 months after R2-resection. Caudal and periampullary tumors had the best prognosis, as well as tumors without nodal metastases. High lymph node yield (≥15 nodes) was reported in 18 patients.

Table 2 Detailed Survival Estimates of the 92 Patients Resected for PDAC. A Kaplan-Meier Log-Rank Analysis

	Number of Patients	Median Overall Survival and 3-Year Survival Rate	p-value
Resection margins			<0.001
R0	73 (79%)	45.8 months (55%)	
R1	11 (12%)	20.3 months (9%)	
R2	8 (9%)	10.3 months (0%)	
T-stage			ns (0.06)
0–2	33 (43%)	61.5 months (67%)	
3	36 (47%)	32.4 months (33%)	
4	7 (9%)	16.7 months (21%)	
R2 resection/missing	16		
N-stage			0.01
0	35 (39%)	45.8 months (54%)	
1 (1–3 nodes)	41 (46%)	36.1 months (51%)	
2 (≥4 nodes)	14 (16%)	19.0 months (14%)	
Missing	2		
Tumor location			not tested
Head (C25.0)	53 (58%)	31.5 months (37%)	
Corpus (C25.1)	7 (9%)	26.7 months (0%)	
Cauda (C25.2)	5 (6%)	not reached (100%)	
Other (C25.x)	3 (5%)	18.9 months (0%)	
Periampullary	23 (25%)	47.1 months (61%)	
Sex			ns (0.8)
Women	40 (43%)	33.3 months (43%)	
Men	52 (57%)	34.6 months (42%)	
Age			ns (0.6)
<70 years	60 (65%)	34.8 months (49%)	
≥70 years	32 (35%)	26.0 months (41%)	
Comorbidities			ns (0.9)
No	55 (60%)	36.6 months (42%)	
Yes	37 (40%)	40.3 months (47%)	
Ca19-9 > 500 kU/l			
No	73 (89%)	33.3 months (45%)	ns (0.2)
Yes	9 (11%)	22.6 months (40%)	

(*Continued*)

Table 2 (Continued).

	Number of Patients	Median Overall Survival and 3-Year Survival Rate	p-value
Smoking status			
Never/former	54 (69%)	34.6 months (43%)	ns (0.2)
Current	24 (31%)	25.5 months (29%)	
Adjuvant chemotherapy duration			ns (0.2)
Yes (≥4 months)	52 (57%)	36.1 months (50%)	
Yes (<4 months or unknown)	17 (18%)	38.5 months (54%)	
No	23 (25%)	20.6 months (31%)	

Adjuvant chemotherapy was given for 69 patients; 34 treated with gemcitabine, 19 with gemcitabine-capecitabine, 6 with miscellaneous regimens, 10 with unspecified regimes and 23 patients (including eight R2-resections) did not receive adjuvant chemotherapy. A trend favouring longer mOS among the adjuvant-treated patients was observed (Table 2).

Definitive Radiotherapy Outcomes

mOS was 23.1 months among the 26 dRT patients as compared to 10.6 months among the 62 systemic therapy only patients with LA-PDAC (HR 0.29 (0.17–0.52)). Baseline demographics were comparable between these two groups (Supplementary Table 1). After adjusting with age >70 years, sex, comorbidities, ECOG performance status 2+, and BMI < 21 kg/m^2, the adjusted HR was 0.24 (0.12–0.46). Two patients died with 90 days of dRT initiation. Median RFS was 8.4 months (n=19) with 1- and 3-year relapse-free rates of 21% and 5%.

The dRT arm included 21 CRT, two SBRT and three conventional radiotherapy without chemosensitizer treatments. All but three were treated with systemic therapy prior the dRT. CRT was chemosensitized with capecitabine in eight and gemcitabine in 13 patients, with mOS 28.2 and 21.6 months respectively (non-significant). Major reductions in gemcitabine or capecitabine doses were performed in four and three respective patients due to toxicity. One CRT was not completed due to rapid disease progression.

Systemic Therapy Outcomes

Gemcitabine monotherapy was given for 227 patients resulting in mOS of 6.8 months (reference, Figure 3), as compared to 11.6 months for the 47 patients treated with albumin-bound paclitaxel-gemcitabine (HR 0.66 (0.48–0.91), available from 2014 onwards) or 11.8 months for the six patients treated with mFOLFIRINOX regimen (HR 0.50 (0.19–1.34), available from 2019 onwards). The remaining patients received miscellaneous regimens. The only difference in the baseline demographics was that gemcitabine-treated patients were on average three years older (Supplementary Table 2). Among the gemcitabine-treated patients, 106 (47%) were on treatment after three months and 40 (18%) after six months. With albumin-bound paclitaxel-gemcitabine, the respective rates were 41 (87%) and 18 (38%), and 4 (67%) and 0 for mFOLFIRINOX.

Independent key prognostic factors for longer OS were administration of albumin-bound paclitaxel-gemcitabine as opposed to gemcitabine-monotherapy and the presence of lung metastases, while the presence of liver metastases and elevated levels of Ca19-9 were associated with shorter OS (Table 3).

A total of 103/287 (36%) patients initiated second-line chemotherapy, of whom 98 had received gemcitabine with or without paclitaxel as the first-line therapy, and were selected for OS^{2ndline} analysis. Median OS^{2ndline} was 5.0 months with capecitabine (n=43, reference, Figure 3) as compared to 5.0 months with bolus fluorouracil combined with either oxaliplatin or irinotecan (n=41, HR 1.07 (0.69–1.68)) or 4.9 months with gemcitabine continued with the added oral erlotinib (n=10, HR 0.82 (0.40–1.70)).

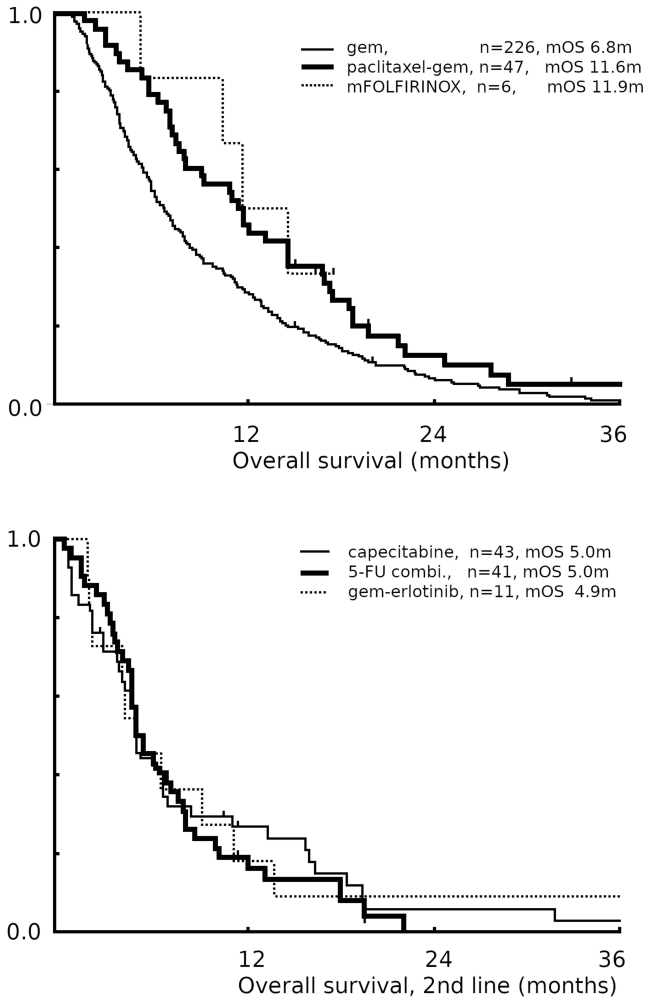

Figure 3 Overall survival according to first-line (upper panel) and second-line (lower panel) systemic therapy. All patients were treated with gemcitabine-based regimen first-line.
Abbreviations: Gem, gemcitabine; mOS, median overall survival.

Discussion

The current study is based on an epidemiologically representative population-based cohort,[29] where we identified all consecutively diagnosed patients with PDAC during the 11-year study period. There were three key observations. Firstly,

Table 3 Overall Survival in PDAC Patients Treated with Systemic Therapy Only. First-Line Use of Albumin-Bound Paclitaxel-Gemcitabine Was Compared Against Single Gemcitabine. Significant Results are in Bold. Hazard Ratio (HR) < 1 Favors Longer Survival and HR > 1 Shorter

Multivariable Covariate	n	Univariate HR (95% CI)	Multivariable HR (95% CI) n=265
Albumin-bound paclitaxel: Yes	274	**0.66 (0.48–0.91)**	**0.36 (0.12–0.91)**
Age: >70 years	287	1.16 (0.89–1.52)	
Sex: Male	287	0.92 (0.72–1.17)	
ECOG: 2+	271	1.27 (0.94–1.69)	
BMI: < 21 kg/m^2	286	1.05 (0.75–1.49)	

(*Continued*)

Table 3 (Continued).

Multivariable Covariate	n	Univariate HR (95% CI)	Multivariable HR (95% CI) n=265
Charlson comorbidity index: > 0	287	1.11 (0.93–1.33)	
Ca19-9 elevated > 500 kU/l: Yes	272	**1.71 (1.34–2.19)**	**1.79 (1.37–2.27)**
Locally advanced PDAC only: Yes	287	**0.72 (0.54–0.96)**	0.85 (0.59–1.20)
Liver involved: Yes	287	**1.59 (1.26–2.02)**	**1.56 (1.15–2.08)**
Peritoneum involved: Yes	287	1.18 (0.84–1.66)	
Lung involved: Yes	287	**0.52 (0.35–0.79)**	**1.36(0.23–0.58)**

among resected patients, a high R0-resection and adjuvant treatment rates were observed, with mOS of 34.6 months, highlighting the need for quality surgery and oncological collaboration. Secondly, patients with unresectable LA-PDAC who received dRT with variable techniques had independently longer mOS as compared to those treated with systemic therapy only. Third, we observed longer mOS with first-line combination chemotherapy over gemcitabine-monotherapy.

An overall resection rate in the current study was 9%, close to the 7% reported earlier in Finland from the period of 2002–2008.[9] R0-resection rate was 72%, being higher than the 40–60% seen in trials[14,16] and the 55–62% reported prior year 2008 in Finland,[4] while equal to the 72–75% reported more recently from Finland.[17,33] In the current study, adjuvant therapy was given for 75% of patients, higher than 42–62% reported prior 2008[4] and 53–68% more recently.[17,33] After upfront pancreatic surgery, we observed mOS of 34.6 months without neoadjuvant or triplet adjuvant regimens, which is close to the trial results reported with similar adjuvant treatment.[12,13] Studies from Finland report mOS of 20–26 months after pancreatic surgery in medium/high volume centres[4,17,33] or 35 months with the neoadjuvant approach.[17] The mOS in our study was also longer than the 20–22 months reported in resected Canadian and Dutch PDAC populations, where R0 rate of 44% and adjuvant rates of 57–64% were reported.[11,34] In the current study, pancreatic tumor was deemed inoperable in situ in 39% of patients, much higher than the 23% observed in the PREOPANC trial.[16]

Our centre utilized dRT as a life-prolonging treatment modality for patients with LA-PDAC,[30,31] instead of a preoperative option, close to the protocol presented in the LAPACT trial.[23] The variability in the radiation techniques has presented challenges also in trials evaluating it against systemic treatment, where survival improvement has been reported in some trials, but not all.[16,22–24] In our small cohort, we observed clinically meaningful mOS of 26 months with dRT (completion rate of 25/26 patients) as compared to 10 months in LA-PDAC treated with systemic chemotherapy only. This is close to the 23 months reported after surgery of LA-PDAC successfully treated with preoperative chemotherapy[35] or the 19 months in the LAPACT trial with 105 patients.[23]

It should be noted that the clinical rationale for treatment allocation is not gathered in the registry studies causing selection bias. Surgery, dRT and systemic therapy groups were in balance according to baseline demographics (Table 1 and Supplementary Table 1), but the classification of borderline or LA-PDAC is unavailable and remains as a potential confounder. The selection bias holds true also for the comparison of mOS after dRT versus systemic therapy, and our results cannot replace the clinical decision-making in patient level.

In our study, the addition of albumin bound-paclitaxel to gemcitabine treatment in LA/metastatic PDAC improved mOS from 6.8 to 11.6 months, close to the 11.3 months observed in a larger real-world registry,[28] and superior to the 8–9 months in trials.[27,36] Patients treated with combination chemotherapy were younger, but not affecting this observation. These findings support the active use of combination chemotherapy in the first-line setting. However, as observed in previous studies, the same does not necessarily hold true after gemcitabine-failure.[37–40] $OS^{2ndline}$ in the current study with capecitabine monotherapy was the same (5.0 months) as with combination regimens, and clinicians should take toxicity issues of combination chemotherapy into account as noted earlier.[40] Ultimately, 60% of patients with PDAC were not treated, close to the 62% reported in Netherlands.[11]

The current retrospective study is limited in the number of patients and due to selection bias discussed above. We gathered only 92 resected patients, of whom a significant proportion was not followed in our hospital, making RFS estimates and survival prognostication inconclusive. Statistical benefit from adjuvant therapy could not be shown, due to marked heterogeneity in the regimens and low number of patients. Since 2018 pancreatic cancer surgery has been centralized in Finland, which has increased the number of pancreatic resections in our institution. Also, neoadjuvant therapies with mFOLFIRINOX or gemcitabine-based regimes were initiated quite late during 2019, and none of the resected patients had prior chemotherapy. Furthermore, information bias may affect the database where physical measures might be misreported. Therefore, the results cannot be directly extrapolated to different healthcare systems without confirmatory, preferably prospective, studies.

In conclusion, the current study presents outcomes in PDAC with comprehensive analysis of multimodality treatments in a centralized healthcare setting. The results suggest that by improving R0 and adjuvant chemotherapy rates, longer survival can be achieved among resected patients, which might be further improved with neoadjuvant approaches. Patients not eligible for surgery have a poor prognosis, but different radiotherapy techniques could provide these patients with prolonged survival. The benefits of combination chemotherapy in advanced PDAC were observed during the first line treatment only.

Abbreviations

BSC, best supportive care; CI, confidence interval; CRT, chemoradiotherapy; dRT, definitive radiotherapy; ECOG, Eastern Cooperative Oncology Group; HR, hazard ratio; LA, locally advanced; mOS, median overall survival; PDAC, pancreatic ductal adenocarcinoma; RFS, relapse-free survival; SBRT, stereotactic body radiotherapy.

Data Sharing Statement

The data may be requested through www.findata.fi/en/.

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Disclosure

The authors report no competing interests in this work.

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