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ORIGINAL ARTICLE – PANCREATIC TUMORS

Quality of Life Following Major Laparoscopic or Open Pancreatic Resection

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ABSTRACT

Purpose. This study was designed to compare quality of life (QoL) among patients who underwent open versus laparoscopic pancreatic resection, including distal pancreatectomy and pancreaticoduodenectomy, and to identify clinical characteristics that are associated with changes in QoL.

Methods. Quality of life (QoL) was assessed in patients undergoing pancreatic resection with the Functional Assessment of Cancer Therapy-Hepatobiliary questionnaire preoperatively and 2 weeks, 1, 3, and 6 months postoperatively. Multilevel regression modeling was used to determine the variability in each QoL domain within the first 2 weeks (postoperative period) and thereafter (recovery period).

Results. Among 159 patients, 60.4% underwent open and 39.6% underwent laparoscopic surgery. Physical, functional, hepatobiliary, and total QoL scores decreased in the postoperative period but returned to baseline levels by 6 months postoperatively. Emotional QoL improved from baseline by 2 weeks after surgery ($p < 0.001$) and social QoL improved from baseline by 3 months after surgery ($p < 0.001$). Emotional QoL was the only domain where significant differences were observed in QoL in the postoperative and recovery periods between patients who underwent open and laparoscopic pancreatic resection. Controlling for surgical approach, patients who experienced a grade III or IV complication experienced greater declines in physical, functional, hepatobiliary, and total QoL in the postoperative period. The negative impact of complications on QoL resolved by 6 months postoperatively.

Conclusions. The impact of pancreatic resection on QoL was comparable between patients who underwent laparoscopic versus open pancreatic resection. Complications were strongly associated with changes in postoperative QoL, suggesting that performing a safe operation is the best approach for optimizing patient reported QoL.

Minimally invasive pancreatic surgery is increasing in prevalence despite initial concern over the feasibility and safety of laparoscopic and robotic techniques for major pancreatic resection.[1,2] Numerous studies have demonstrated minimally invasive approaches to be equivalent to open approaches with regards to complications, hospital length of stay, short-term mortality, and oncologic outcomes at high-volume centers.[1–5]

Pancreatic resection has been shown to impact quality of life (QoL) negatively during the postoperative period.[6–10] However, the effect of minimally invasive surgery on postoperative QoL has not been evaluated. Furthermore, clinical factors that are associated with postoperative changes in QoL and how surgery influences QoL throughout the recovery period have been underexplored.

The Functional Assessment of Cancer Therapy-Hepatobiliary (FACT-Hep) questionnaire contains five subscales (physical, functional, emotional, social, hepatobiliary) and a summative total FACT-Hep score and has been validated in patients with malignant hepatobiliary disease.[11,12] In this

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study, we evaluated QoL following major pancreatic resection using the FACT-Hep questionnaire to compare postoperative QoL among patients who underwent open versus laparoscopic pancreatic resection and to identify clinical characteristics associated with perturbations in QoL.

METHODS

This is a prospective, cohort study of 159 adults who underwent elective laparoscopic or open pancreatic resection, including both distal pancreatectomy and pancreaticoduodenectomy from 2014 to 2016. All patients scheduled for elective surgery during this time period were eligible for study participation ($n = 297$). Patients were randomly approached for study enrollment ($n = 164$) and five patients declined participation (Supplemental Fig. 1). The only exclusion criteria at our institution during this study period for receiving laparoscopic pancreatic resection was the receipt of neoadjuvant therapy or vascular involvement in patients who required pancreaticoduodenectomy. This study was approved by the Colorado Multiple Institutional Review Board (#13-2974).

Patients completed the FACT-Hep questionnaire preoperatively and postoperatively at 2 weeks, 1 month, 3 months, and 6 months.[11] FACT-Hep scores were calculated according to the Functional Assessment of Chronic Illness Therapy Measurement System, where higher scores indicate better QoL.[13] Standardized Cronbach's alpha coefficients were used to determine the internal consistency of the FACT-Hep subscales at each time point.[14]

Patient, disease, treatment characteristics, and survey response rates at each time point were compared between patients who underwent a laparoscopic versus an open procedure, using Chi square tests and Fisher's exact tests. An intention-to-treat design was used; therefore, patients who underwent a planned laparoscopic surgery that required conversion to open surgery ($n = 9$) were analyzed with the laparoscopic cohort. A sensitivity analysis was conducted comparing QoL between patients who underwent a completed laparoscopic versus an open procedure.

Associations between covariates and QoL scores were examined in a multilevel regression analysis with separate models for each QoL domain. A linear spline for time with one knot placed at 2 weeks postoperatively was used to allow for different trajectories within the postoperative (preoperative to 2 weeks postoperative) and recovery periods (2 weeks to 6 months postoperatively).[15] The splines for time, main effects for the selected covariates, and all two-way time and covariate interactions were included as fixed effects, and a patient-specific intercept term was included as the random effect. The fully adjusted models included surgical approach (open vs. laparoscopic), age (dichotomized at the median, ≤ 65 vs. > 65 years), sex, operation type (pancreaticoduodenectomy vs. distal pancreatectomy), and all candidate covariates for which at least one of their two-way interactions with time was statistically significant, at the alpha 0.25 level.

Predictive margins based on the fully adjusted models were calculated and are presented as adjusted QoL scores. Adjusted QoL scores at 2 weeks and 1, 3, and 6 months postoperatively were compared with preoperative levels in each QoL domain, using Wald Chi square tests. Correction for multiple tests used the Bonferroni method.

A two-sided significance level of alpha 0.05 was used for all presented statistical tests. All analyses were performed using Stata version 15.1 (StataCorp LLC, College Station, TX).

RESULTS

Patient Characteristics

A total of 159 patients who underwent pancreaticoduodenectomy (71.7%) or distal pancreatectomy (28.3%) were enrolled. Ninety-six patients (60.4%) underwent open surgery (77 pancreaticoduodenectomies and 19 distal pancreatectomies), and 63 patients (39.6%) underwent laparoscopic surgery (37 pancreaticoduodenectomies and 26 distal pancreatectomies). There were no differences between the open and laparoscopic cohorts with regards to patient demographics, proportion of patients with a cancer diagnosis, or hospital length of stay, complications, 90-day readmission, and receipt of adjuvant chemotherapy. Patients in the open cohort were more likely to receive neoadjuvant chemotherapy than the laparoscopic cohort (25.0% vs. 0.0%, $p < 0.001$) and had a higher proportion of pancreaticoduodenectomies than the laparoscopic cohort (80.2% vs. 58.7%, $p = 0.003$; Table 1).

QoL Assessment

The median questionnaire response rate was 4 out of 5 (interquartile range, 3–5). Response rate was highest preoperatively (96.9%) and decreased to 69.2% at 6 months. There were no differences in response rates between the open and laparoscopic cohorts preoperatively (95.8% vs. 98.4%, $p = 0.649$) or at 6 months postoperatively (66.7% vs. 73.0%, $p = 0.396$). However, patients in the open cohort had a lower response rate compared with the laparoscopic cohort at 2 weeks (72.9% vs. 92.1%, $p = 0.003$), 1 month (74.0% vs. 88.9%, $p = 0.022$), and 3 months postoperatively (65.6% vs. 81.0%, $p = 0.026$). The internal consistency of the FACT-Hep QoL

TABLE 1 Patient, disease, and treatment characteristics of the study cohort by surgical approach

	Surgical approach						*p* value
	Open (*n* = 96)		Laparoscopic (*n* = 63)		Total (*n* = 159)		
	No.	%	No.	%	No.	%	
Sex							
Female	48	50.00	38	60.32	86	54.09	0.202
Male	48	50.00	25	39.68	73	45.91	
Age at surgery (years)							
65 or younger	44	45.83	36	57.14	80	50.31	0.163
Older than 65	52	54.17	27	42.86	79	49.69	
Diagnosis							
Cancer	73	76.04	41	65.08	114	71.70	0.133
Benign	23	23.96	22	34.92	45	28.30	
Neo-adjuvant chemotherapy							
No	72	75.00	63	100.00	135	84.91	< 0.001
Yes	24	25.00	0	0.00	24	15.09	
Operation							
Distal pancreatectomy	19	19.79	26	41.27	45	28.30	0.003
Pancreaticoduodenectomy	77	80.21	37	58.73	114	71.70	
Length of stay (from date of surgery)							
8 days or fewer	46	47.92	40	63.49	86	54.09	0.054
Greater than 8 days	50	52.08	23	36.51	73	45.91	
Complications							
No complications	32	33.33	17	26.98	49	30.82	0.242
Grade I–II[a]	46	47.92	27	42.86	73	45.91	
Grade III–IV[a]	18	18.75	19	30.16	37	23.27	
Ninety-day readmission							
No	75	78.13	43	68.25	118	74.21	0.164
Yes	21	21.88	20	31.75	41	25.79	
Adjuvant chemotherapy							
No	52	54.17	44	69.84	96	60.38	0.069[b]
Yes	40	41.67	19	30.16	59	37.11	
Unknown	4	4.17	0	0.00	4	2.52	

[a]Worst complication grade, Clavien-Dindo Scale

[b]*p* value from Fisher's exact test, in all other cases *p* values are from Chi square tests

questionnaire was adequate at each survey time point (standardized Cronbach's alpha: 0.80, 0.76, 0.81, 0.81, and 0.86).

QoL in the Postoperative and Recovery Periods

Among all patients who underwent pancreatic resection, physical, functional, hepatobiliary, and total QoL decreased in the immediate post-operative period (preoperative to 2 weeks postoperative) followed by an increase in these QoL scores over the recovery period (2 weeks to 6 months postoperative; Supplemental Fig. 2). On multivariable analysis, factors significantly associated with perturbations in total QoL in the postoperative period include male sex and grade III–IV complications. Factors significantly associated with perturbations in total QoL in the recovery period include undergoing pancreaticoduodenectomy, prolonged length of stay, and grade III–IV complications (Table 2). A sensitivity analysis was performed using the same multivariable model but excluding patients who underwent a laparoscopic converted to open pancreatic resection and all significant changes in QoL remained.

Distal Pancreatectomy Versus Pancreaticoduodenectomy

Unadjusted QoL scores for each domain stratified by operation type and laparoscopic versus open approach are presented in Supplemental Fig. 3, demonstrating similar

TABLE 2 Multilevel regression analysis of patient, disease, and treatment characteristics associated with each of the FACT-Hep and Total QoL scales following pancreatic resection

	Physical[b] *B* [95% CI][c]	Emotional[b] *b* [95% CI][c]	Social[b] *b* [95% CI][c]	Functional[b] *b* [95% CI][c]	Hepatobiliary[b] *b* [95% CI][c]	FACT-Hep Total[b] *b* [95% CI][c]
Approach (Ref. open)						
Post-op	− 1.99 [− 5.76, 1.79]	− 3.05* [− 5.77, − 0.33]	0.82 [− 1.53, 3.17]	− 1.92 [− 6.03, 2.20]	− 5.54 [− 12.15, 1.07]	− 11.44 [− 25.76, 2.89]
Recovery	0.07 [− 0.33, 0.47]	0.42** [0.13, 0.70]	0.08 [− 0.17, 0.32]	0.07 [− 0.37, 0.51]	0.38 [− 0.33, 1.08]	1.02 [− 0.50, 2.54]
Sex (Ref. female)						
Post-op	− 4.63* [− 8.25, − 1.01]	− 3.09* [− 5.58, − 0.59]	− 1.57 [− 3.73, 0.59]	− 7.12*** [− 11.05, − 3.18]	− 9.03** [− 15.37, − 2.69]	− 25.67*** [− 39.35, − 11.99]
Recovery	0.14 [− 0.25, 0.53]	0.07 [− 0.20, 0.34]	0.04 [− 0.19, 0.28]	0.35 [− 0.07, 0.78]	− 0.06 [− 0.75, 0.63]	0.50 [− 0.98, 1.99]
Age (Ref. ≤ 65 years)						
Post-op	0.28 [− 3.40, 3.96]	0.52 [− 2.02, 3.07]	− 1.03 [− 3.21, 1.15]	− 1.45 [− 5.45, 2.54]	− 1.55 [− 8.00, 4.90]	− 3.98 [− 17.90, 9.95]
Recovery	− 0.19 [− 0.58, 0.21]	0.04 [− 0.24, 0.31]	0.21 [− 0.03, 0.44]	0.08 [− 0.35, 0.51]	0.12 [− 0.58, 0.81]	0.34 [− 1.16, 1.83]
Cancer (Ref. Benign)						
Post-op	2.92 [− 1.30, 7.13]	− 3.21* [− 6.16, − 0.26]	1.75 [− 0.82, 4.32]	4.04 [− 0.58, 8.66]	0.95 [− 6.44, 8.34]	4.96 [− 11.14, 21.06]
Recovery	− 0.10 [− 0.58, 0.38]	− 0.13 [− 0.44, 0.18]	− 0.18 [− 0.47, 0.11]	− 0.19 [− 0.71, 0.33]	− 0.10 [− 0.95, 0.74]	− 0.73 [− 2.55, 1.08]
Neo-adjuvant chemotherapy (Ref. none)						
Post-op		− 3.64 [− 7.56, 0.28]	0.55 [− 2.84, 3.94]			
Recovery		0.38 [− 0.05, 0.81]	− 0.18 [− 0.57, 0.20]			
Whipple (Ref. distal pancreatectomy)						
Post-op	− 0.81 [− 5.26, 3.63]	2.53 [− 0.54, 5.59]	1.01 [− 1.64, 3.66]	− 1.63 [− 6.51, 3.24]	− 0.21 [− 8.01, 7.58]	1.67 [− 15.34, 18.68]
Recovery	− 0.72** [− 1.21, − 0.23]	− 0.28 [− 0.61, 0.06]	− 0.12 [− 0.41, 0.18]	− 0.48 [− 1.02, 0.05]	− 0.46 [− 1.33, 0.40]	− 2.14* [− 4.01, − 0.27]
Prolonged Length of Stay (Ref. ≤ 8 days)						
Post-Op	− 5.44** [− 9.45, − 1.44]	− 0.61 [− 3.37, 2.14]		− 2.98 [− 7.32, 1.36]	− 4.05 [− 11.06, 2.97]	− 12.05 [− 27.16, 3.06]
Recovery	0.53* [0.10, 0.96]	0.28 [− 0.01, 0.58]		0.38 [− 0.09, 0.85]	0.57 [− 0.18, 1.33]	1.71* [0.08, 3.34]
Complication Grade I–II (Ref. no complications)[a]						
Post-op	− 0.85 [− 5.19, 3.49]	− 0.24 [− 3.23, 2.74]	0.55 [− 1.99, 3.08]	− 1.38 [− 6.12, 3.36]	− 3.86 [− 11.47, 3.74]	− 6.43 [− 22.94, 10.08]
Recovery	− 0.06 [− 0.54, 0.42]	− 0.03 [− 0.36, 0.29]	0.00 [− 0.28, 0.27]	− 0.09 [− 0.61, 0.43]	− 0.22 [− 1.06, 0.62]	− 0.36 [− 2.17, 1.46]
Complication Grade III–IV (Ref. no complications)[a]						
Post-op	− 6.05* [− 11.53, − 0.57]	− 3.18 [− 6.97, 0.61]	− 0.83 [− 3.99, 2.33]	− 8.46** [− 14.43, − 2.48]	− 11.77* [− 21.37, − 2.17]	− 30.24** [− 51.10, − 9.39]
Recovery	0.48 [− 0.12, 1.08]	0.33 [− 0.08, 0.74]	0.27 [− 0.07, 0.62]	0.69* [0.04, 1.34]	0.63 [− 0.42, 1.68]	2.44* [0.17, 4.70]
Adjuvant chemotherapy (Ref. none)						
Post-op	N/A	N/A	N/A	N/A	N/A	N/A
Recovery	− 0.19 [− 0.93, 0.56]		0.44 [0.00, 0.89]	− 0.43 [− 1.23, 0.38]	− 0.81 [− 2.12, 0.49]	− 0.97 [− 3.78, 1.84]

Blank spaces represent variables not included in the model for that domain, N/A indicates an inestimable value due to a time-variant covariate

All models included a random effect for patient

b, estimated beta coefficient; 95% CI, 95% confidence interval; FACT-Hep, Functional Assessment of Cancer Therapy-Hepatobiliary

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$

[a]Worst complication grade, Clavien-Dindo scale

[b]Coefficient and 95% confidence interval for two-way interaction time *x* covariate

[c]Number of observations included in model: Physical (obs = 624), Emotional (obs = 635), Social (obs = 622), Functional (obs = 623), Hepatobiliary (obs = 623), FACT-Hep Total (obs = 621)

trajectories in QoL for each operation by surgical approach. On univariate multilevel analysis, preoperative QoL scores were not significantly different between patients who underwent pancreaticoduodenectomy versus distal pancreatectomy.

Changes in QoL in the postoperative and recovery periods between patients who underwent distal pancreatectomy and pancreaticoduodenectomy are shown in Fig. 1. On multivariable analysis, there were no statistically significant differences in the changes in QoL in the postoperative period (preoperative to 2 weeks postoperative) between patients who underwent pancreaticoduodenectomy versus distal pancreatectomy (Table 2). However, patients who underwent pancreaticoduodenectomy had a significantly slower recovery of physical and total QoL scores in the recovery period (2 weeks to 6 months postoperative) compared with patients who had a distal pancreatectomy, independent of postoperative complications and surgical approach (laparoscopic vs. open; Table 2).

Surgical Approach: Laparoscopic Versus Open

On univariate multilevel analysis, preoperative physical, functional, and total QoL scores were significantly higher for the laparoscopic cohort of patients than the open cohort (p = 0.012, 0.017, 0.046, respectively). Because none of the patients in the laparoscopic group received neoadjuvant chemotherapy versus 25% of patients in the open group, baseline QoL scores between the two groups were compared, including only those in the open group who did not receive neoadjuvant chemotherapy and the differences in preoperative physical, functional, and total QoL scores persisted. These differences may be attributable to the selection bias involved in assignment of surgical approach.

On multivariable analysis, changes in QoL in the postoperative and recovery periods between patients who underwent open and laparoscopic pancreatic resection followed similar trajectories (Fig. 2). There were no differences in the rate of decline in physical, functional, hepatobiliary, or total QoL in the postoperative period between groups. Similarly, there were no difference between groups in the rate of improvement in these domains of QoL in the recovery period. Social QoL

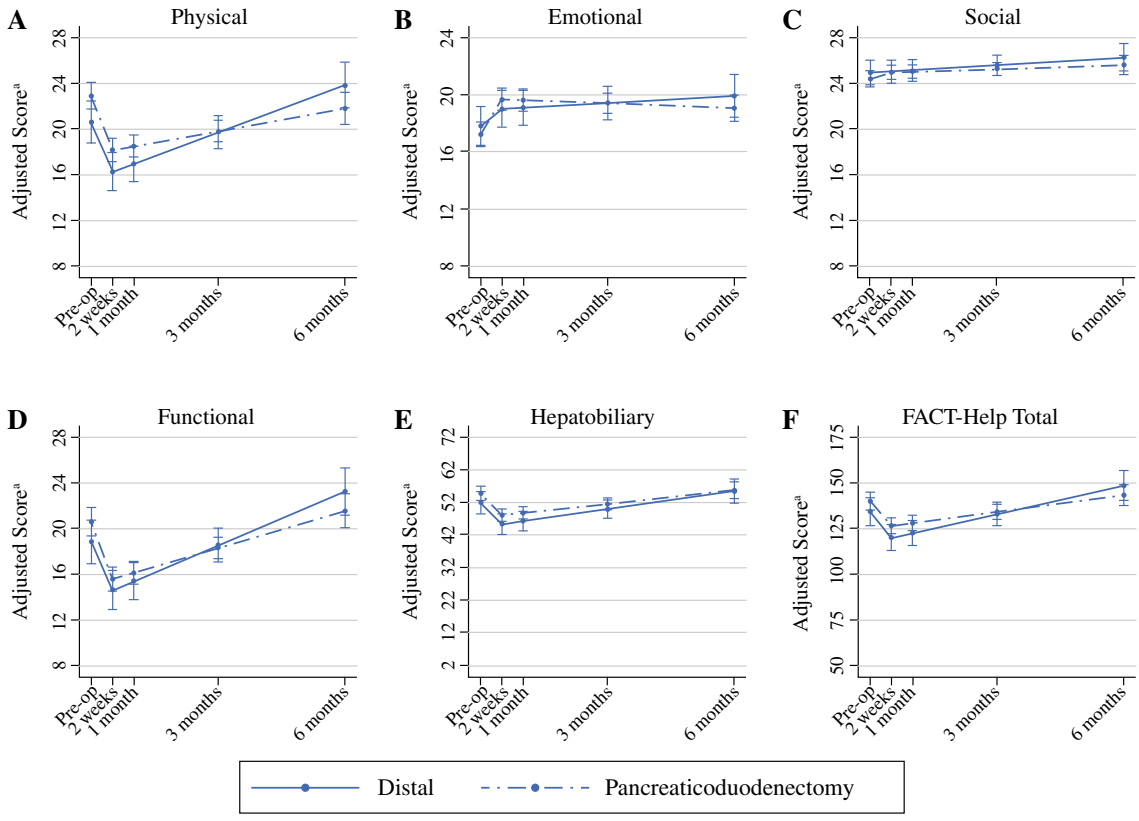

FIG. 1 Change in predicted adjusted FACT-Hep subscales (**a**–**e**) and total (**f**) QoL scores by operation (distal pancreatectomy and pancreaticoduodenectomy) from preop to 6 months following pancreatic resection. [a]Predictive margins calculated based on the multilevel model for each domain

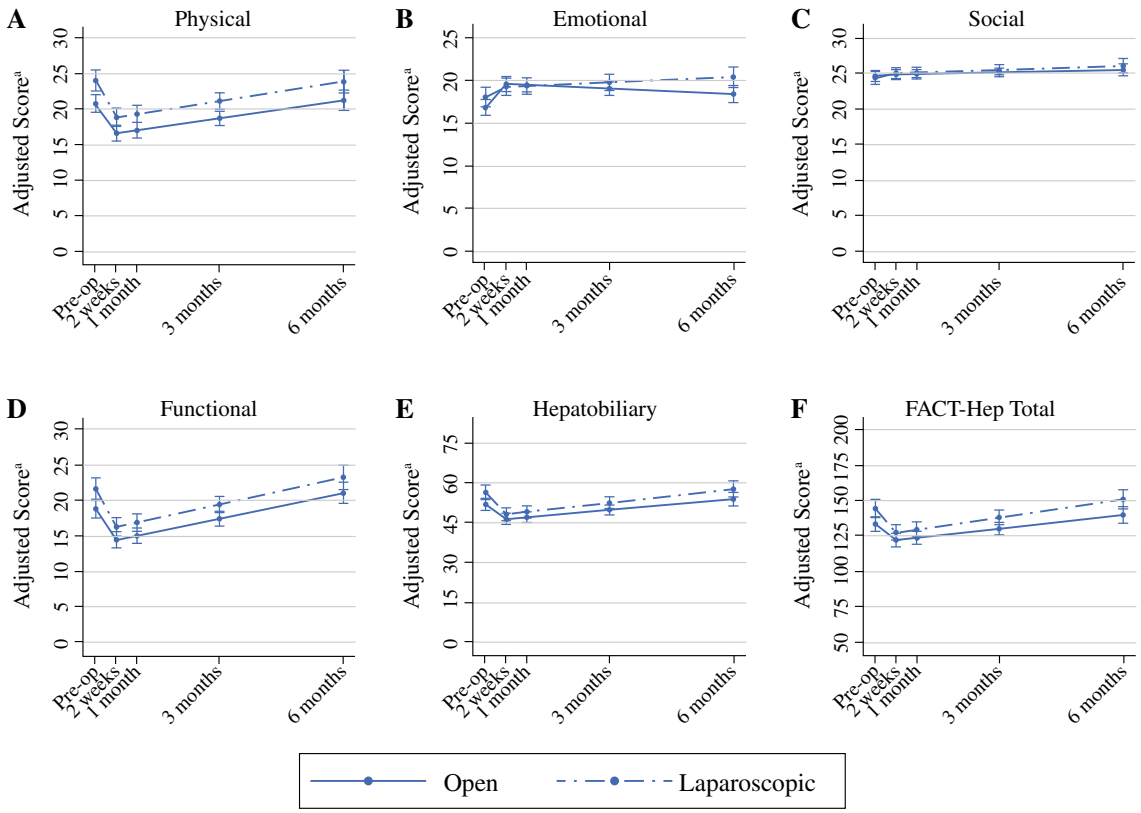

FIG. 2 Change in predicted adjusted FACT-Hep subscale (**a**–**e**) and total (**f**) qol scores by surgical approach from preop to 6 months following pancreatic resection. [a]Predictive margins calculated based on the multilevel model for each domain

remained stable for both groups over the postoperative and recovery periods. Emotional QoL was the only domain that demonstrated a statistically significant difference by surgical approach. Patients who underwent open surgery had a greater increase in emotional QoL in the postoperative period ($p < 0.01$). However, patients who underwent laparoscopic surgery had a greater improvement in emotional QoL during the recovery period than those in the open surgery cohort ($p < 0.001$; Table 2). An interaction term between the type of operation and the surgical approach was used to investigate whether the effect of the approach on QoL was different among those who underwent pancreaticoduodenectomy versus distal pancreatectomy and no difference was found. Therefore, the interaction term was not included in the models.

Despite the decline in physical, functional, hepatobiliary, and total QoL in the postoperative period for both open and laparoscopic groups, these QoL scores returned to preoperative levels or higher by 6 months postoperatively. Emotional QoL scores exceeded baseline levels as early as 2 weeks postoperatively (Supplemental Table 1).

Postoperative Complications

Postoperative complications had a significant impact on the change in QoL scores in the postoperative period (Fig. 3). On multivariable analysis, patients who experienced a grade III or IV complication experienced greater declines in physical, functional, hepatobiliary, and total QoL in the postoperative period compared with patients with no complication. Complication severity was not significantly associated with changes in emotional and social QoL (Table 2; Fig. 3).

While severe complications were associated with a decrease in QoL in the postoperative period, patients who experienced a severe complication still reported QoL scores that were equivalent to or exceeded preoperative scores by 6 months following surgery (Supplemental Table 2).

DISCUSSION

As minimally invasive pancreatic resection is increasing in prevalence, we aimed to investigate prospectively whether the negative impact of pancreatic surgery on QoL was reduced in patients who underwent minimally invasive

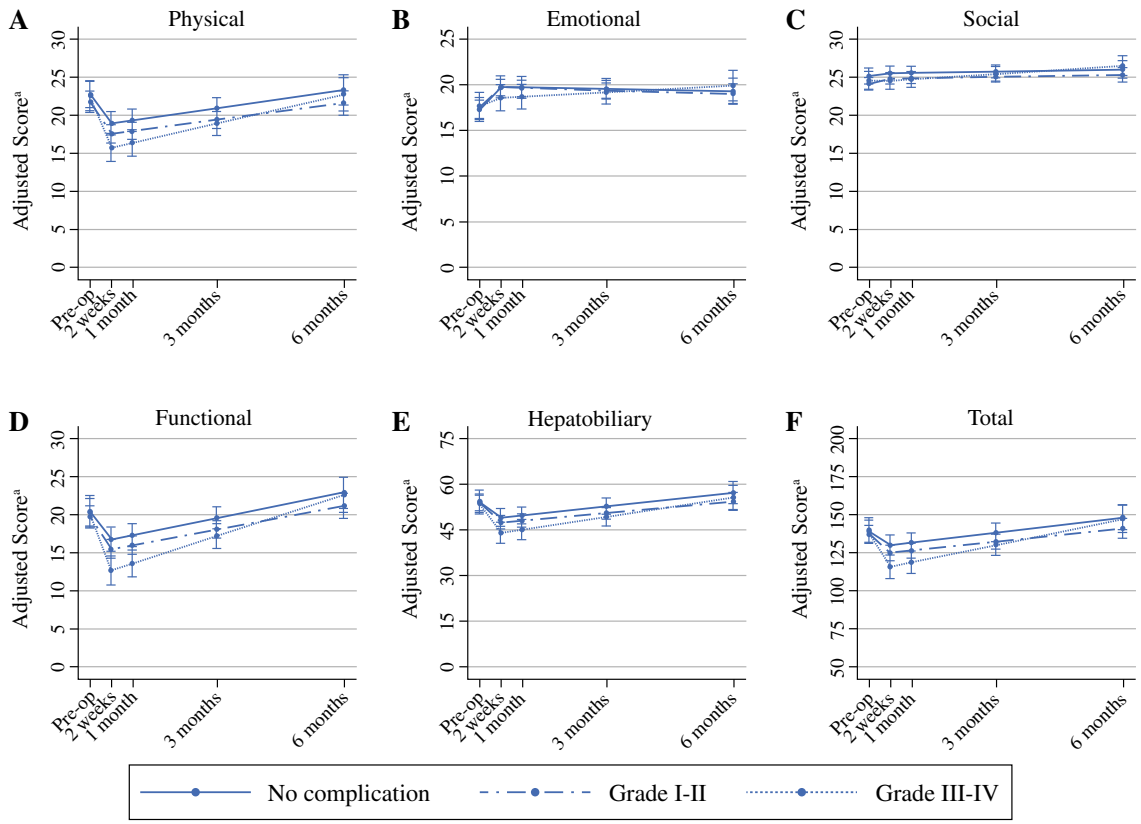

FIG. 3 Change in predicted adjusted FACT-Hep subscale (**a**–**e**) and total (**f**) QoL scores by worst complication grade from preop to 6 months following pancreatic resection. [a]Predictive margins calculated based on the multilevel model for each domain

surgery. Our results show that after controlling for patient and treatment characteristics, operation type, and postoperative complications, the negative impact of pancreatectomy on QoL in the postoperative period is comparable between patients who underwent laparoscopic versus open pancreatic resection. Both the minimally invasive and open cohorts demonstrated equivalent improvement in all QoL domains during the recovery period, with the exception of emotional QoL, which increased more in the minimally invasive cohort. While surgical approach did not impact QoL, complications were a key driver of changes in postoperative QoL.

Numerous QoL questionnaires have been used to evaluate post-operative QoL, including the European Organization for Research and Treatment of Cancer quality of life questionnaire (EORTC QLQ-C30), the Short Form Healthy Survey (SF-36), and the FACT-Hep questionnaire. We used the FACT-Hep questionnaire in this study, because it is well validated and includes general QoL metrics and a hepatobiliary symptom specific domain.[11,12] The baseline and 6 month postoperative QoL scores for our patient cohort were similar to the normative scores of the general U.S. adult population and the long-term QoL scores of pancreatectomy patients reported by Cloyd et al.[16,17]

Our results demonstrated that physical, functional, and hepatobiliary QoL scores were most negatively impacted by surgery at 2 weeks postoperatively followed by gradual improvement thereafter. Emotional QoL showed evidence of improvement as early as 2 weeks postoperatively. These trends are consistent with those previously reported for patients who underwent open pancreatic resection.[6–10] In the largest study to date evaluating QoL following pancreatectomy, Eaton et al. administered the EORTC QLQ-C30 and the pancreas specific PAN26 questionnaire to 300 patients preoperatively and at 2 weeks and 2 months postoperatively. At 2 weeks postoperatively, all functional QoL domain scores (physical, role, cognitive, social, and global health) were worse than preoperative levels, except for emotional functioning.[9] Similarly, Schniewind et al. evaluated QoL in 91 patients with pancreatic ductal adenocarcinoma undergoing pancreaticoduodenectomy using the EORTC QLQ-C30 and reported significant declines in all QoL domains at the time of discharge. However, by 3 to 6 months postoperatively, all QoL domain scores were

comparable to preoperative scores, which is consistent with our findings of normalization in QoL during the recovery period.[7]

Complications were associated with changes in postoperative QoL in this study. Patients who experienced a Clavien-Dindo grade III–IV complication had greater declines in QoL in the postoperative period. One previous study by Heerkens et al. evaluated the impact of postoperative complications on QoL in patients undergoing pancreatectomy and found no differences in QoL between patients with severe postoperative complications (≥ Clavien-Dindo grade III) and patients without severe complications at 1, 3, 6, or 12 months after surgery.[18] Such discrepancy is likely a result of a difference in the time points at which QoL was measured. We administered a survey at 2 weeks postoperatively, a time point not captured by Heerkens and colleagues. Not surprisingly, patients reported the lowest QoL at 2 weeks postoperatively for physical, functional, hepatobiliary, and total QoL. However, by 1 month, QoL in these domains demonstrated an upward trajectory. This is further supported by our finding that QoL in all domains is equivalent between patients with no complications, grade I-II complications, or grade III-IV complications at the 6-month time point.

This is the first study to evaluate the association between minimally invasive surgical technique and QoL following major pancreatectomy. The use of minimally invasive surgical techniques has been demonstrated to improve postoperative QoL following cholecystectomy, splenectomy, and esophagectomy.[19,20] However, QoL following laparoscopic-assisted colectomy and laparoscopic Nissen fundoplication was found to be equivalent to patients who underwent open surgery.[21,22] Our results show that the negative impact of pancreatic resection on QoL in the postoperative period is comparable between patients who underwent laparoscopic versus open pancreatectomy. Both the minimally invasive and open cohorts also demonstrated an equivalent improvement in QoL during the recovery period. Emotional QoL was the only domain to demonstrate significant differences between surgical approaches; patients in the minimally invasive cohort had greater improvement of emotional QoL in the recovery period. A significant strength of our study was the use of multivariable models, which controlled for the covariates of operation type, gender, diagnosis, postoperative complications, length of hospital stay, 90-day readmissions, and chemotherapy. The operation type, pancreaticoduodenectomy versus distal pancreatectomy, also was considered. There was no significant interaction between the type of surgery and the surgical approach in the multivariable model demonstrating that the effect of the approach on QoL was similar for both operations.

A limitation of this study is the unestablished sensitivity of the FACT-Hep questionnaire to detect changes in QoL that may be related to minimally invasive surgery, such as the impact of postoperative narcotics use and incisional discomfort. However, the FACT-Hep questionnaire has been well validated in patients with pancreatic cancer, demonstrating worse QoL scores for patients receiving chemotherapy compared with patients off treatment and excellent responsiveness to changes in ECOG performance status.[11,12] The dramatic responses we saw in physical, functional, hepatobiliary, and total QoL in the first 2 weeks following surgery also demonstrates the FACT-Hep questionnaire captures the impact of surgery on postoperative QoL. A second limitation of our study is the impact of response bias due to a significant difference in questionnaire response rates between patients in the minimally invasive and open cohorts at the intermediate time points, which may confound our results. Patients in the open cohort had a significantly lower response rate at 2 weeks, 1 month, and 3 months following surgery. We are unable to rule out the possibility that the decreased response rate may have been due to poor QoL in the nonresponders at these times points. Despite this limitation, survey response rates were equivalent between the minimally invasive and open cohorts at 6 months following surgery, and no differences in QoL were detected at this time point. Our questionnaire response rate of 69.2 to 96.9% across all time points compare favorably to prior QoL studies in pancreatectomy patients that employed repeated measurements.[6–8]

CONCLUSIONS

Quality of life is significantly reduced in the postoperative period following major pancreatic resection; however, QoL returns to baseline levels or better by 6 months postoperatively. Complication severity, but not surgical approach, drives QoL following major pancreatic resection, suggesting that performing a safe operation is the best approach for optimizing patient reported QoL. With increased experience, minimally invasive approaches may decrease the negative impact of surgery on the QoL through reducing postoperative complications.

DISCLOSURES The authors declare no conflicts of interest.

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