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# Oncological outcomes of multivisceral operations with pancreatoduodenalectomy for colorectal cancer

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**ABSTRACT** *AIM: to estimate early and late outcomes of multivisceral surgeries (MVS) with pancreaticoduodenalectomy (PD) for colorectal cancer.*
*PATIENTS AND METHODS: the main group included 42 patients who underwent MVS with PD for colorectal cancer from January 2011 to April 2024. The control group included 46 patients with colorectal cancer who underwent colorectal resection with resection of the duodenum and/or head of the pancreas, i.e. MVS without PD.*
*RESULTS: controls were more likely to have ECOG status 2-3 (44/46 (95.7%) vs. 33/42 (78.6%), p = 0.022), were more likely to have tumor stenosis of the colon/duodenum (31/46 (67.4%) vs. 16/42 (38.1%), p = 0.006), were less likely to have ischemic heart disease (6/46 (13.0%) vs. 14/42 (33.3%), p = 0.023), and were less likely to have pancreatic invasion (5/46 (10.9%) vs. 20/42 (47.6%), p = 0.001). Control patients (MVS without PD) received adjuvant chemotherapy (ACT) significantly more often (34/46 (73.9%) vs. 21/42 (50.0%), p = 0.021). The incidence of postoperative complications by Clavien-Dindo grade 3 and higher and mortality in both groups were comparable (13/42 (31%) vs. 11/46 (23.9%), p = 0.2) and (3/42 (7.1%) vs. 3/46 (6.5%), p = 1,0), respectively. The risk of locoregional recurrence in the control group was significantly higher (18/43 (41.9%) vs. 4/33 (12.1%), p = 0.005). Locoregional recurrence was an independent negative factor of prognosis in the control group (HR 3.96; 95% CI (1.66–9.44), p = 0.002). Overall five-year survival in the main group (MVS with PD) was 42.1%, (95% CI (17.2–65.4), and in the control one (MVS without PD) — 26.4% (95% CI (11.8–43.6). The median overall survival in the main group was 44 months (95% CI: 26 — ∞), in the control one — 13 (95% CI: 10–31). The differences in overall survival rates were significant (p = 0.005). The risk of mortality in the late period in the control group was significantly higher (HR 2.49; 95% CI (1.27–4.91), p = 0.008). In univariate analysis, superior mesenteric vein invasion had a significant effect on overall survival (HR 21.84; 95% CI (1.52–313.78), p = 0.02.) The only independent factor of negative prognosis is metastases in 4 or more regional lymph nodes (N2 of the primary tumor). Multivariate analysis revealed that independent negative factors for overall survival rates were locoregional recurrence (HR 4.65; 95% CI (2.1–10.44), p < 0.001), invasion of the superior mesenteric vein (HR 41.77; 95% CI 4.25–409.73, p = 0.001), and positive factors were the fact of performing MVS with PD (HR 0.29; 95% CI (0.12–0.7), p = 0.005) and adjuvant chemotherapy (HR 0.34; 95% CI 0.14–0.8, p = 0.013).*
*CONCLUSION: multivisceral resection with pancreaticoduodenectomy for local advanced colorectal cancer with duodenal and / or pancreatic head invasion is the operation of choice in the presence of appropriate conditions.*

**KEYWORDS:** *colorectal cancer, pancreaticoduodenectomy, overall survival, locoregional recurrence*

**CONFLICT OF INTERESTS:** *the authors declare no conflict of interests*

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## INTRODUCTION

Pancreatoduodenal resection (PDR) is the method of choice for tumors of the periampular area [1]. Performing PDR even in the standard volume is associated with a high incidence of postoperative complications, reaching 69% and a mortality rate of 3–6% [2].

PDR can also be performed for other malignancies (not of the periampular area) as part of the so-called multivisceral procedures: for large intestine, stomach, bile ducts, gallbladder, kidney cancers [3,4,5].

MVS with PDR in colorectal cancer is followed by an even higher rate of postoperative morbidity, reaching 75% and mortality — up to 25%. In this regard, the indications for such a surgery should be extremely balanced, despite the higher survival rate in this group [6].

There are few studies on MVS with PDR for local advanced colorectal cancer with invasion of the duodenum and/or the head of the pancreas. As a rule, this is a description of individual clinical cases or a series of several patients, systematic reviews of the surgery results of several studies [7,8,9,10]. Studies on the pancreatoduodenal resection in colorectal cancer have also been presented in the Russian literature [11,12], where its positive role in improving late outcomes has been shown, but the factors influencing early and oncological outcomes have not been fully analyzed. In order to obtain representative data, we united the experience of the MVS with the PDR for colorectal cancer from two Russian cancer clinics.

AIM

To assess early and late outcomes of multivisceral procedures with pancreatoduodenal resection for colorectal cancer.

## PATIENTS AND METHODS

The study is retrospective, cohort, multicenter, controlled. The main group included all patients who underwent MVS with PDR for colorectal cancer at two institutions (N.N. Blokhin National Research Medical Center of Oncology of the Ministry of Health of the Russian Federation and the Republican Clinical Oncology Dispensary of the Ministry of Health of the Republic of Tatarstan named after Professor M.Z. Segal) from January 2011 to April 2024. In total, 42 MVS with PDR for colorectal cancer were performed during this time. Of these, 36 (85.7%) had local advanced colorectal cancer with invasion of the duodenum and/or the head of the pancreas (PH), 6 (14.3%) were cases of primary multiple synchronous tumors (a combination of malignant neoplasms of the periampular area and colorectal cancer).A cohort of colorectal cancer patients who underwent duodenal and/or PH resection with colorectal resection over the same time interval was selected for the control group (MVS without PDR) — 46 patients. Clinical invasion of a tumor refers to radiological and visual (during surgery) signs of fusion between the tumor and the duodenum and/or pancreatic head (PH). The inclusion criteria in the first group were morphologically confirmed colorectal cancer, a combination of colorectal resection with pancreatoduodenal resection for tumor ingrowth in the PH and/or duodenum, as well as for primary multiple synchronous tumors (colorectal cancer + tumor of the periampular area). The inclusion criteria in the second group were morphologically confirmed colorectal cancer, colon resections with partial resection of the duodenum and/or PH due to the tumor ingrowth into the head of the pancreas and/or duodenum.

It should be noted that the criterion for excluding patients from the second group was situations where the surgery volume (resection of duodenum and pancreatic head instead of PDR) was due to the general unsatisfactory condition of the patient and the presence of other conditions that caused an unreasonably high risk of performing PDR. Patients with R2 resection were also excluded in the presence of a macroscopically detectable residual tumor on the wall of the duodenum or pancreatic head. Patients who underwent diagnostic laparotomies and bypass anastomoses were excluded. In other words, the second group consisted of patients who underwent duodenal and/or PH resection in the same cases when there were conditions for performing PDR. These criteria were developed in order to maximize comparison and achieve uniformity in the compared groups.

Lymphnode dissection in the group of patients with MVS with PDR included removal of groups of lymph nodes in the right half of the colon (201, 202,

203, 211, 212, 213, 221, 222, 223) + 214 + lymph nodes of the pancreatoduodenal area and the perigastric area (part 4d, 5, 6, 7, 8, 9) + hepatoduodenal ligament — group 12a.

When analyzing the late outcomes (locoregional recurrence, overall survival rates), all six patients with primary multiple synchronous tumors and all deceased patients in both groups were excluded from the MVS group with PDR.

***Statistical Analysis***

The statistical analysis was performed using the StatTech v. 4.4.1 program (developed by Stattech LLC, Russia).

Quantitative indicators were evaluated for compliance with the normal distribution using the Shapiro-Wilk criterion. Quantitative indicators with a normal distribution were described using arithmetic averages (M) and standard deviations (SD), the limits of the 95% coincidence interval (95% CI). In the absence of a normal distribution, quantitative data were described using the median (Me), lower and upper quartiles (Q1–Q3). Categorical data were described with absolute values and percentages. The comparison of the two groups by a quantitative indicator with a normal distribution, provided that the variances were equal, was performed using the Student's t-test. The comparison of the two groups by a quantitative indicator, the distribution of which differed from the normal one, was performed using the Mann-Whitney U-test. The percentages compared in the analysis of four-field conjugacy tables were performed using Pearson's $\chi^2$ criterion (for expected phenomenon values greater than 10), and Fisher's two-way exact criterion (for expected phenomenon values less than 10). The comparison of percentages in the analysis of multifield conjugacy tables was performed using Pearson's $\chi^2$ criterion.

To conduct a multivariate analysis, methods of both step-by-step exclusion (analysis of overall survival in a combined group of patients) and forced inclusion (analysis of locoregional recurrence in the group of MVS with PDR) were used. The patients' survival function was assessed using the Kaplan-Meyer's method. The analysis of patient survival was carried out using the Cox's regression method, which involves predicting the risk of an event for the object under consideration and assessing the influence of predefined independent variables (predictors) on this risk. Risk is considered as a time-dependent function. The risk ratio was assessed with 95% CI. The differences were considered statistically significant at $p < 0.05$.

## RESULTS

In total, the study included a cohort of 42 patients with colorectal cancer who underwent MVS with PDR: the first group and 46 patients with colorectal cancer with clinical signs of invasion of the duodenum and/or pancreatic head, who underwent MVS without PDR (a combined surgery including resection of the colon, duodenum and/or PH). It should be noted that there were no cases of R2 resection in the second group.

At the first stage, the main clinical and demographic indicators of the studied patients were compared (Table 1).

As follows from Table 1, the patients were comparable in most indicators. The main difference was: patients in the MVS group without PDR were more likely to have a 2–3 ECOG status *(44 (95.7%) vs. 33 (78.6%), p = 0.022)*, which is probably due to the fact that they were more likely to have colon/duodenal tumor stenosis *(31 (67.4%) vs. 16 (38.1%) p = 0.006)*. In the MVS group without PDR, coronary heart disease was less common: AP *(6 (13.0%) vs. 14 (33.3%), p = 0.023)* and pancreatic invasion was less common *(5 (10.9%) vs. 20 (47.6%), p = 0.001)*. Patients in the MVS group without PDR were significantly more likely to receive ACT *(73.9% vs. 50.0%, p = 0.021)*.

The ACT regimens in the first group were: capecitabine in mono mode — 10 patients, XELOX — 10 patients, FOLFOX — 1 patient. In the second group: capecitabine — 18 patients, XELOX — 6, Mayo scheme — 5 patients, FOLFOX — 3 patients, FOLFIRI — 2 patients. The median

**Table 1.** *Comparative analysis of clinical and demographic indicators*

| Indicators | MVS with PDR (N = 42) | MVS without PDR (N = 46) | *p*-value |
|---|---|---|---|
| Gender | | | 0.8 |
| Male | 23 (54.8) | 24 (52.2) | |
| Female | 19 (45.2) | 22 (47.8) | |
| Age as per WHO (years) | | | 0.5 |
| Young (18–44) | 7 (16.7) | 4 (8.7) | |
| Middle (45–59) | 13 (31.0) | 14 (30.4) | |
| Elderly (60–74) | 16 (38.1) | 23 (50.0) | |
| Old (75–90) | 6 (14.3) | 5 (10.9) | |
| Age (years) | 60.1 ± 14.6 (55.4–64.6) | 62.5 ± 12.2 (58.9–66.1) | 0.3 |
| BMI (kg/m$^{2)}$ | 24 ± 4.04 (22.7–25.2) | 24.1 ± 4.5 (22.71–25.4) | 0.9 |
| ECOG | | | **0.022** |
| 0-1 | 9 (21.4) | 2 (4.3) | |
| 2-3 | 33 (78.6) | 44 (95.7) | |
| ASA | | | 0.19 |
| 1-2 | 30 (71.4) | 39 (84.8) | |
| 3 | 12 (28.6) | 7 (15.2) | |
| DM not ID | 5 (11.9) | 4 (8.7) | 0.7 |
| DM ID | 2 (4.8) | 4 (8.7) | 0.6 |
| CHD | 17 (40.5) | 16 (34.8) | 0.5 |
| CHD: AP | 14 (33.3) | 6 (13.0) | **0.023** |
| CHD: PICS | 1 (2.4) | 1 (2.2) | 1.0 |
| CHD: CA | 5 (11.9) | 10 (21.7) | 0.2 |
| CVD | 0 | 1 (2.2) | 1.0 |
| HT | 19 (45.2) | 29 (63.0) | 0.09 |
| Obesity | 6 (14.3) | 6 (13.0) | 1.0 |
| Anemia | 33 (78.6) | 43 (93.5) | 0.06 |
| Tumor stenosis | 16 (38.1) | 31 (67.4) | **0.006** |
| Intoxication/abscess | 15 (35.7) | 17 (37.0) | 0.9 |
| N | | | 0.9 |
| 0 | 21 (50.0) | 22 (47.8) | |
| 1 | 18 (42.9) | 20 (43.5) | |
| 2 | 3 (7.1) | 4 (8.7) | |
| M | | | 0.6 |
| 0 | 33/36 (91.7) | 44 (95.7) | |
| 1 | 3/36 (8.3) | 2 (4.3) | |
| Stage | | | 0.7 |
| 2 | 15/36 (41.7) | 21 (45.7) | |
| 3 | 18/36 (50.0) | 23 (50.0) | |
| 4 | 3/36 (8.3) | 2 (4.3) | |
| Histogenesis | | | 0.09 |
| Adenocarcinoma | 42 (100) | 42 (91.3) | |
| Mixed cancer | 0 | 4 (8.7) | |
| Differentiation | 4 (9.5) | 3 (6.5) | 0.5 |
| G1 | 21 (50.0) | 19 (41.3) | |
| G2 | 17 (40.5) | 24 (52.2) | |
| G3 | | | |
| Invasion of Duodenum | 20 (47.6) | 5 (10.9) | **0.001** |
| Invasion of SMV | 2 (4.9) | 0 | 0.2 |
| Ca 19-9, Units/ml | 111.8 (56.2–479.4) | 14.3 (10.5–28.2) | < 0.001 |
| CEA, Units/ml | 3.8 (3.4–4.04) | 16.01 (5.5–137.1) | 0.06 |
| ACT | 21 (50.0) | 34 (73.9) | **0.021** |

*Note: BMI — body mass index, DM — diabetes mellitus, ID — insulin–dependent, CHD — coronary heart disease, AP — angina pectoris, CA — cardiac arrhythmia, PICS — post infarction cardiosclerosis, CVD — cerebrovascular disease, HT — hypertension, SMV — superior mesenteric vein, ACT — adjuvant chemotherapy*

**Table 2.** *Comparative analysis of early outcomes*

| Indicator | MVS with PDR (N = 42) | MVS without PDR (N = 46) | *p*-value |
|---|---|---|---|
| Clavien-Dindo<br>Class 1–2 Class 3 and higher | 11 (26.2)<br>13 (31.0) | 7 (15.2)<br>11 (23.9) | 0.2 |
| Pancreatonecrosis | 0 | 3 (6.5) | 0.2 |
| Pancreatic fistula | 7 (16.7) | 9 (19.6) | 0.7 |
| Bowel fistula | 3 (7.1) | 1 (2.2) | 0.3 |
| Intra-abdominal abscess | 1 (2.4) | 1 (2.2) | 1.0 |
| Bleeding from the surgical area | 1 (2.4) | 0 | 0.4 |
| Bleeding from stoma chulcers | 1 (2.4) | 1 (2.2) | 1.0 |
| Diarrhea | 2 (4.8) | 2 (4.3) | 1.0 |
| Relaparotomy | 2 (4.8) | 3 (6.5) | 1.0 |
| Pneumonia | 1 (2.4) | 2 (4.3) | 1.0 |
| Diabetes mellitus | 3 (7.1) | 0 (0.0) | 0.1 |
| Gastrostasis | 10 (23.8) | 5 (10.9) | 0.15 |
| Postoperative mortality | 3 (7.1) | 3 (6.5) | 1.0 |
| Operation time (minutes) | 285 (242.5–380) | 190 (142.5–243.7) | **< 0.001** |
| Bloodloss (ml) | 550 (250–1475) | 125 (100–200) | **< 0.001** |
| Hospital stay after surgery (days) | 15 (13–17.5) | 14.0 (11.2–17.7) | 0.6 |

number of ACT courses was comparable in both groups, *6 (5–6) versus 6 (4–6), p = 0.6*.

It should be noted that in the MVS group with PDR, the number of lymph nodes examined was significantly higher *(16 (12–19) vs 12 (10–14), p = 0.002)*. According to the results of a pathomorphological study, three (8.3%) of the 36 patients in the MVS group with PDR had metastases in lymph nodes outside the regional lymph flow of the right colon: in one case — in group 214, in two cases — in group 13. These metastases are staged as M1.

Next, the early surgical outcomes in two groups were analyzed (Table 2).

As shown in Table 2, the early outcomes in both groups were comparable. It is expected that the surgeries in the MVS group with PDR were significantly longer *(285 (242.5–380) minutes versus 190 (142.5–243.7), p < 0.001),* and were accompanied by a large intraoperative blood loss *(550 (250–1475) ml versus 125 (100–200), p < 0.001)*.

Further, the latetreatment results in two groups of patients were analyzed. For this purpose, patients with PMST (6 people) were excluded from the first group, and those who died in the early postoperative period from complications of surgery (3 patients from each group) were excluded from both groups. Thus, 33 patients of the first group and 43 patients of the second group were included to study late results. All (100%) patients from the second group had pT4 colorectal cancer, two (6%) of the 33 patients in the first group had a pT3 tumor, and the rest (94%) had pT4.Locoregional recurrence (at follow–up from one to 40 months) was significantly more likely to develop in the MVS group without PDR: *18/43 (41.9%) vs 4/33 (12.1%)* in the MVS group with PDR, *p = 0.005*. Locoregional recurrence (rate — 41.9%) was an independent and negative factor, affecting the survival of patients in the MVS group without PDR. The risk of mortality in the late period among these patients was 3.9 times higher than in patients without recurrence*(3.96 HR; 95% CI (1.66–9.44), p = 0.002)*. In three out of four (75%) patients in the MVS group with PDR, a locoregional recurrence developed due to the lymph nodes of the hepatoduodenal ligament of groups 12-p and 12-b, since the 12-a group of lymph nodes was included in the volume of lymphnode dissection during the first procedure. In the intragroup analysis of risk factors for locoregional recurrence in the MVS group without PDR, neither the invasion of the duodenum, nor the invasion of the pancreatic head, nor the volume of resection of the duodenum (full-layered or without mucosa), nor the degree of tumor differentiation were independent factors and had a comparable effect (Table 3).

A comparative analysis of overall survival in the studied groups was carried out (Fig. 1).

**Table 3.** *Analysis of risk factors for locoregional relapse in the MVS group without PDR*

| Indicators | Recurrence (–), N = 25 | Recurrence (+), N = 18 | *p* |
|---|---|---|---|
| Differentiation grade<br>G1<br>G2<br>G3 | 2 (8.0)<br>11 (44.0)<br>12 (48.0) | 1 (5.6)<br>6 (33.3)<br>11 (61.1) | 0.7 |
| Invasion into Pancreas | 3 (12.0) | 2 (11.1) | 1.0 |
| N + | 12 (48.0) | 10 (55.6) | 0.8 |
| Resection of Pancreas | 4 (16.0) | 7 (38.9) | 0.16 |
| Resection of uodenum | 23 (92.0) | 15 (83.3) | 0.6 |

**Table 4.** *Factors influencing overall survival in group MVS with PDR*

| Risk factor | Unadjusted value | | Adjusted value | |
|---|---|---|---|---|
| | HR; 95% CI | *p*-value | HR; 95% CI | *p*-value |
| N1 | 1.7; 0.5–6.04 | 0.38 | 1.2; 0.3–4.7 | 0.7 |
| N2 | 5.2; 0.9–29.3 | 0.057 | 6.5; 1.1–38.3 | **0.036** |
| G3 | 2.2; 0.7–6.9 | 0.17 | 2.6; 0.7–9.3 | 0.14 |

The overall 5-year survival rate in the MVS group with PDR was *42.1% (95% CI (17.2–65.4))*, and in the MVS group without PDR — *26.4% (95% CI (11.8–43.6))*. The median OS in the MVS group with PDR was *44 months (95% CI: 26–∞)*, in the MVS group without PDR — *13 months (95% CI: 10–31)*. The differences in overall survival rates assessed using the likelihood ratio test turned out to be statistically significant *(p = 0.005)*.

The risks of mortality in the late period in the MVS group without PDR increased by 2.49 times compared with the MVS group with PDR*(2.49 HR; 95% CI (1.27–.91), p = 0.008)*.

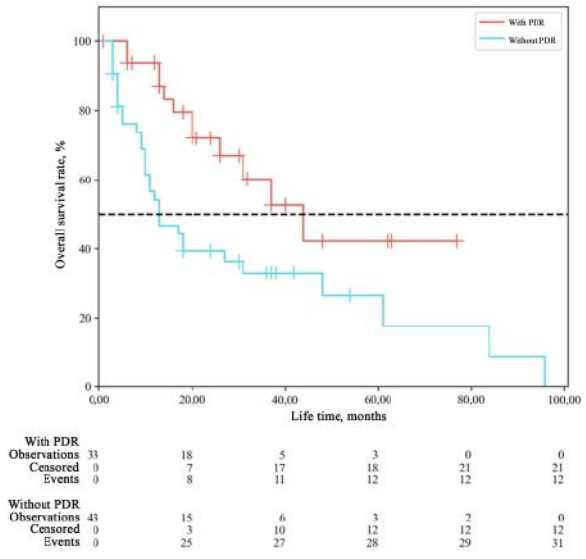


**Figure 1.** *Comparative analysis in both groups of patients*

Next, we analyzed the factors that influenced the survival of patients in the group of MVS with PDR. In a univariate analysis, the factor that significantly affected overall survival was invasion of the superior mesenteric vein *(21.84 HR; CI (1.52–313.78), p = 0.023)*, other parameters (gender, age, ECOG, ASA, comorbidities, tumor stage, differentiation, presence of ACT, Ca 19-9 level, CEA) had no significant effect on survival. In a multivariate analysis (forced inclusion), it was found that metastases in 4 or more regional lymph nodes (N2) in the MVS group with PDR have a significant negative effect on the prognosis of overall survival (Table 4).

Next, a multivariate analysis was performed (gender, age, ECOG, ASA, N tumor condition, comorbidities, tumor stage, differentiation, presence of ACT, CA 19-9, CEA, type of surgery, tumor invasion into veins) with step-by-step exclusion, after combining patients from both groups to identify factors affecting on survival rates (Fig. 2 and Table 5).

As follows from Figure 2 and Table 5, independent negative factors affecting overall survival rates were, first of all, locoregional recurrence *(HR 4.65; 95% CI (2.1–10.44), p < 0.001)*, invasion into the superior mesenteric vein *(HR 41.77; 95% CI 4.25–409.73, p = 0.001)*, and the positive factor was the fact that MVS was performed with PDR*(HR 0.29; 95% CI (0.12–0.7), p = 0.005)* and adjuvant chemotherapy *(HR 0.34; 95% CI 0.14–0.8, p = 0.013)*.

**Table 5.** *Multivariate analysis of overall survival rate*

| Risk factor | Unadjusted value | | Adjusted value | |
|---|---|---|---|---|
| | HR (95% CI) | *p*-value | HR (95% CI) | *p*-value |
| MVS with PDR | 0.35 (0.16–0.75) | 0.007* | 0.29 (0.12–0.7) | 0.005* |
| Invasion into veins: | 5.94 (0.76–46.1) | 0.08 | 41.77 (4.25–409.73) | 0.001* |
| ACT | 0.98 (0.47–2.02) | 0.95 | 0.34 (0.14–0.8) | 0.013* |
| Locoregional recurrence | 3.82 (1.92–7.6) | < 0.001* | 4.68 (2.1–10.44) | < 0.001* |

## DISCUSSION

In this paper, we compared the results of two possible surgical options for colorectal cancer with duodenal and/or pancreatic head invasion, and it was important that in both groups the patients were homogenous in basic indicators, ECOG and ASA. That is, partial resection instead of PDR was performed not as a consequence of the severity of the patient's condition, the initial intra- and postoperative risks. There are known works where this aspect was not initially given much attention, and therefore the results could not be completely comparable [12,13].

The indicators of the early results of MVS with PDR in colorectal cancer in the study generally correspond to PDR in the standard volume, without resection of adjacent organs, which indicates their acceptable tolerability in cases performed in large specialized centers [1,2].

The comparable results of the postoperative period in both groups allow us to state: MVS with PDR in colorectal cancer with invasion into the duodenum and/or pancreatic head does not worsen the early results compared with partial resection of the duodenum or pancreas as part of MVS. This is important, but it cannot be an argument for the last volume of the surgery.

One of the justifications, but not the only one, for the volume of surgery in the second group of patients was that the surgeon regarded the invasion not as a true tumor, but as a result of peritumoral inflammatory adhesions, and therefore economic resection of the duodenum or pancreatic head was performed. Histology revealed that pT4 tumors were present in 34 out of 36 patients in the first group (94.4%) and in all (100%) patients of the second group. The difficulty of differentiating between true tumor invasion and the peritumoral adhesive-inflammatory process has also been noted by other authors [6]. It was also previously established that the presence of tumor complications, including inflammatory changes, is a negative prognostic factor [14].

It is noteworthy that low tumor differentiation was the *most common* and occurred in 41 (46.6%) of 88 patients, which suggests that colorectal

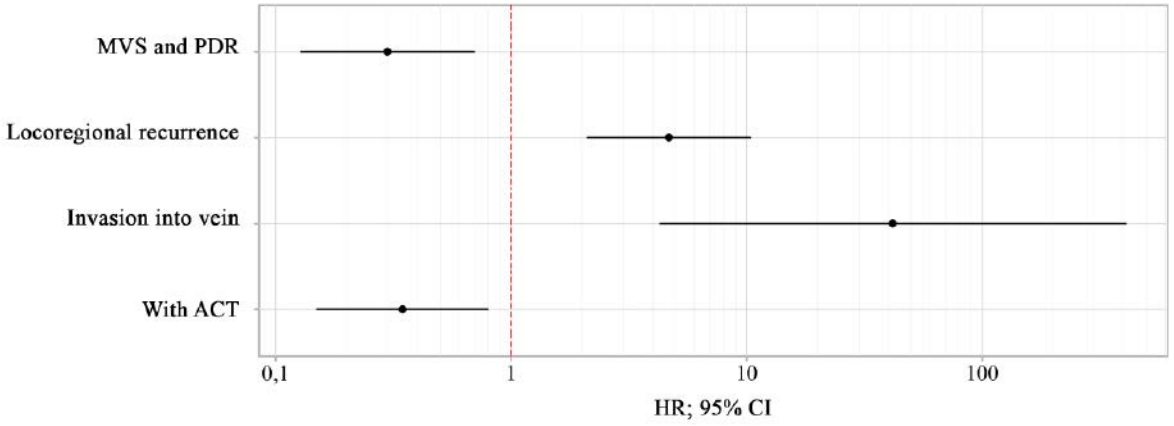


**Figure 2.** *Multivariate analysis of overall survival rate*

cancer with invasion into the duodenum and/or pancreatic head is initially more malignant.

In the group of patients with MVS without PDR, locoregional recurrence (both local and due to pancreatic duodenal lymph nodes) was significantly more often, which was the main factor of negative impact on overall survival. MVS with PDR allowed not only to remove the tumor *en bloc*, but also to perform adequate lymph node dissection in the pancreatoduodenal area. This allowed two (5.5%) patients (excluding the identified cases of metastases in the lymph nodes of the pancreatoduodenal area) out of 36 to identify metastases at the base of the superior mesenteric artery (M1). This fact suggests that MVS with PDR can maximize local oncological radicality and prevent the risk of locoregional recurrence. *MVS with PDR* in a multivariate analysis was an independent factor that significantly improved overall survival rates.

The level of 5-year overall survival and median survival obtained by us generally corresponds to the literature data for both groups with such a tumor prevalence [6, 13]. In the MVS group without PDR, patients were significantly more likely to receive ACT, which should have given these patients an advantage in the long term. However, significantly better survival rates in the MVS group with PDR suggest that this surgery, by achieving local tumor control, allows for better survival rates in patients with colorectal cancer with invasion into the duodenum and/or pancreatic head.

It has been established that NACT plays an important role in the treatment of local advanced colorectal cancer and allows not only to improve overall survival rates, but also to reduce the volume of surgery due to the reduction of the primary tumor [15]. However, in the study, none of the 33 patients in the MVS group with PDR who had oncological results were able to undergo perioperative chemotherapy due to the general condition and complicated tumor. This fact suggests that in patients with colorectal cancer with invasion intoduodenum and / or pancreatic head, the implementation of NACT presents significant difficulties due to the general condition against the background of a complicated course of the tumor.

The N2 tumor stage and the low degree of differentiation are generally negative prognostic factors in colorectal cancer [16,17]. In the study, patients most often had a low degree of tumor differentiation and stage N2, which significantly worsened the late prognosis of patients in the MVS group with PDR. We have shown that 75% of cases of locoregional recurrence in the MVS group with PDR were caused by metastases to lymph nodes in groups 12-p and 12-b, which predisposes to the need to include these groups of lymph nodes in the volume of lymph dissection.

Given the complexity and rarity of MVS with PDR in colorectal cancer, it is almost impossible to conduct prospective studies, especially randomized ones. In our opinion, one of the possible ways to solve this problem is to analyze the late combined clinical experience of several large oncological clinics.

## CONCLUSION

The interpretation of clinical signs of invasion into the duodenum and / or the head of the pancreas, as a result of peritumoral inflammatory-adhesive processes in local advanced colon cancer, ***is more often erroneous***. Their acute separation or limitation of the surgery by partial resection of the duodenum and/or the head of the pancreas is not recommended, as this does not ensure oncological radicality.

Pancreatoduodenal resection in colorectal cancer has similar results in early outcomes compared with economic resections of the duodenum and pancreatic head with initially comparable clinical and demographic indicators of patient groups.

Pancreatoduodenal resection in colorectal cancer with invasion into the duodenum and/or pancreatic head can significantly prevent the risk of locoregional recurrence and significantly increase patient survival rates compared with partial resections of the duodenum and/or pancreatic head,

and all groups (12-a, 12-p, 12-b) of lymph nodes in the hepatoduodenal ligament should be included in the volume of lymph dissection.

Given the presented representative material and the early and late results obtained, it is reasonable to recommend multivisceral resection with pancreatoduodenal resection for local advanced colon cancer with *clinical* signs of invasion into the duodenum and/or pancreatic head as the surgery of choice, provided ***appropriate conditions*** are available for their implementation.

**AUTHORS CONTRIBUTION**

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