Safety and hazards of middle-life robotic pancreaticoduodenectomy

Hassan A. Saad (✉ Ebramos_2010@yahoo.com)  
Zagazig University

Azza Baz  
Alahrar Teaching Hospital

Mohamed Riad  
Zagazig University

Mohamed E Eraky  
Zagazig University

Ahmed K El-Taher  
Zagazig University

Mohamed I Farid  
Zagazig University

Khaled Sharaf  
Zagazig University

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Abstract

Pancreaticoduodenectomy procedures were performed early in young individuals, with a few days about the risk and survival after robotic pancreaticoduodenectomy.

Our goal was to report the results of robotic pancreaticoduodenectomy in patients older than 50 years.

Methods

Our patients were divided into two groups: younger patients (less than 50 years) and older patients (> 50 years). A total of 1110 patients were included in this study: 1004 (90.5%) in the elderly group and 106 (9.5%) in the young group.

Results

In younger demographics, the prevalence of periampullary cancer is 32.1% as opposed to 76.5%.

2. Tumors biological (15.1% versus 3.6%).

3. Pseudocapillary and solid malignancies (9.4% and 1.0%, respectively).

4. The tissues soft of the pancreas (77.4% vs. 62.5%).

There was a higher prevalence of non-dilated (≤ 3 mm) ducts within the pancreas (77.4% vs. 46.3%) in the younger group.

6. Young people group's hospitalization was less (median, 16 vs. 20 days).

7- The younger group fared better after treatment for total periampullary cancers of the with a 5-year prognosis of 76.4% compared to 46.7% in the older category.

8. The results of the other surgeries didn't vary significantly.

Conclusions

Robotic pancreaticoduodenectomy is associated with favorable survival outcomes for periampullary cancer in younger people (<50 years) and equivalent surgical outcomes compared to older individuals (≥50 years). These outcomes show that robotic pancreaticoduodenectomy is safe and effective in a subset of pediatric patients.

Following pancreaticoduodenectomy, the number of juvenile robotic tumor adenocarcinomas

Introduction
Complex and challenging pancreaticoduodenectomy, sometimes called the "Whipple operation," is typically performed in elderly patients with pancreatic cancer and periampullary diseases. Younger patients rarely undergo pancreaticoduodenectomy, and the impact of age on surgical and survival outcomes remains unclear [1].

Patients in their 30s or 40s are rarely found to have pancreatic duct adenocarcinoma, which is often detected in patients aged 65–75 years of age [2, 3]. The influence of youth on surgical and survival outcomes following pancreaticoduodenectomy has not been thoroughly investigated given its uncommon occurrence in younger patients. There is limited literature in this field [1, 2, 4, 5].

Traditionally, an open technique is used to perform pancreaticoduodenectomy using a high abdominal incision, right saber slash, or lengthy upper midline incision. This leads to severe pain and, sometimes, even negative outcomes [6]. Minimally invasive surgery (MIS) has become the norm in several specialties, including pancreatic resection, owing to reduced pain, improved cosmesis, and smaller incisions. According to certain findings, older people can have laparoscopic pancreaticoduodenectomy (LPD) with good results [7–9]. However, pancreaticoduodenectomy entails precise identification of the vital vascular anatomy, considerable dissection and removal of visceral organs, and technically challenging repair. As a result, minimally invasive pancreaticoduodenectomy is not widely used [10]. In light of the limits of laparoscopic surgery, the possibility of automated surgery has lately surfaced, thanks to the introduction of the Intelligent Surgical® da Vinci Robotic Surgical Machine (Sunnyvale, California, USA). With the use of this sort of technology, surgeons can perform tremor-free operations with their instruments and cameras, monitor the surgical region in three dimensions with higher resolution, and increase their range of motion by using endoscopes that mirror open surgical techniques.

Although these improvements improve flexibility, reduce tiredness in surgeons, and improve design, they are not as widely employed due to their substantial medical expenses and lack of operator expertise [10, 11]. Despite its sluggish adoption, numerous research investigations have shown that robotic pancreaticoduodenectomy (RPD) is a secure and feasible approach when contrasted with laparotomy [6, 10, 12, 13].

There's a dearth of studies on pancreaticoduodenectomy in patients who are younger; therefore, most of the available data on the results of surgery and therapeutic options originates from investigations of older people. Consequently, it is uncertain how cancer biology and treatment results vary between both elderly and younger populations. RPD in younger demographics has not been the subject of any studies yet. Our research evaluated a younger participant population (less than 50 years old) receiving RPD at our facility with an older patient cohort (> 50 years old) undergoing RPD in order to gain insight into the clinicopathological features, surgery-related results, and longevity results of these young individuals.

**Patients and methods**

**Patient Choice**
The study included patients who underwent RPD at 7 surgical institutes between January 2012 and October 2023, and data were collected at our institute; 74 cases later, the learning curve for the RPD was surmounted. The first RPD was completed in January 2012.

The patients were divided into two categories based on age: young (less than 50 years) and old (> 50 years). Any patient with a history of surgery and marked adhesion > 2 cm, especially in the upper part of the abdomen, was excluded from our study.

**Data gathering**

All data related to patient characteristics and tumor features were collected, and patients were classified physically by the American Society of Anesthesiologists (ASA). All Preoperative, intraoperative, and postoperative morbidities were evaluated. The likelihood associated with surgery, such as fatality and different postoperative difficulties, was also evaluated. Incidence of periampullary adenocarcinoma death has also been reported.

**Aim of Study Outcomes:**

The primary aim of this study was to compare the safety and risks of our case categories. The secondary study goal was to compare survival between the two groups.

**Method procedures**

A brief internal stent was inserted for a small pancreatic duct measuring less than 3 mm, although pancreatic duct stents are not commonly employed. The same jejunal limb was then used for hepaticojejunostomy without stenting, with either continuous (for dilated) or interrupted (for non dilated ducts) sutures. By carefully lowering the stomach, an extracorporeal technique was used to perform a hand-sewn gastrojejunostomy. The gastrojejunostomy was placed in framesocolic, antecolic, and antiperistaltic positions close to the umbilical region. When feasible, a restricted antrectomy was performed following right gastric artery bifurcation in patients with an ischemic pylorus, instead of attempting pylorus-preserving pancreaticoduodenectomy. Oral liquid after 24 h and soft diet after 3 days, with no need for NGT feeding.

The Clavien-Dindo classification was used to categorize surgical complications [14]. According to the 2016 International Study Group for Pancreatic Fistula revised grading system [15], clinically meaningful grade B or C pancreatic leakage constitutes the definition of postoperative pancreatic fistula (POPF). The International Study Group of Pancreatic Surgery (ISGPS) established classification criteria for delayed gastric emptying (DGE), post-pancreatectomy hemorrhage (PPH), and chyle leak [16–18].

Based on the state of the resection margin, complete radical resection was performed in three cases: if there was no microscopic evidence of cancer at a resection margin of less than 1 mm, the resection was classified as R0; if there was microscopic evidence of cancer at a resection margin of less than 1 mm, it was classified as R1; and if there was a strong positive margin, it was classified as R2. Mortality that
occurs within three months of surgery, involving the hospitalization period after surgery, is referred to as surgical mortality.

The clinicopathological features of the patients’ retrospective data on the preoperative, perioperative, and postoperative features were gathered. Some of the most common factors that were known about patients before and after surgery were age, sex, body mass index (BMI), comorbidities, ASHA score, obstructive jaundice, preoperative percutaneous transhepatic cholangial drainage (PTCD), tumor location, pathological type, largest tumor diameter, number of lymph nodes harvested, operation duration, estimated blood loss (EBL), and blood transfusion. Postoperative complications and the duration of hospital stay (LOS) were among the postoperative features. Intra-abdominal bleeding, chyle leakage, delayed gastric emptying (DGE), and clinically relevant postoperative pancreatic fistula (CR-POPF) are terms used by the International Study Group on Pancreatic Surgery (ISGPS) (9–12).

Positioning the patient, placing the trocar, and docking

The Da Vinci Si Surgical System (Intuitive Surgical, Sunnyvale, CA, USA) was used to carry out the robotic procedures. The patients were placed in a supine 20° reverse Trendelenburg position with their legs spread apart and a small inclination to the left. The assisting surgeon was positioned between the patient’s legs. A 12-mm camera port was positioned below the umbilicus (Figure 1). Before docking, the scope was introduced to examine the abdominal cavity and rule out distant metastases after pneumoperitoneum induction. Subsequently, the robotic system was connected to the head of the patient. For R1 (the first robotic arm), an 8-mm trocar was positioned at the intersection of the left midclavicular line and the horizontal line of the umbilicus. The second robotic arm, R2, was positioned 2-3 cm below the ribs at the right anterior axillary line. R3 (the third robotic arm) and a 12-mm assistance trocar were positioned on the contralateral side, opposite to R1 and R2. Maintaining a spacing of 10–15 cm between neighboring robotic arms minimized the interference.

To perform a preliminary pancreatic examination, the gastrocolic ligament was opened. The right transverse colon, mesocolon, and hepatic colonic flexure were moved downward so that the duodenum and pancreatic head could be clearly seen. After dividing the retropancreatic region, the superior mesenteric vein (SMV) was visible. The GCT or gastrocolic trunk was later ligated. A portion of the distal stomach was removed with the aid of 60-mm linear cutter staplers (Echelon, Johnson & Johnson, USA). The common hepatic artery (CHA) was visualized by dissecting the top margin of the pancreas. After ligating the gastroduodenal artery (GDA) and right gastric artery (RGA) at their roots, the portal vein (PV) was visible. After the gallbladder was removed, the hepatoduodenal ligament was skeletonized and the common hepatic duct was separated. The superior mesenteric artery (SMA) was exposed using the right posterior "artery-first" technique. To view the aorta (AA) and left renal vein (LRC), an extended Kocher maneuver was used to dissect, retract, and then reposition the duodenum and the pancreatic head medially. The dissection of the SMA was approximately 1 cm superior to the LRC. We decided to cut the inferior pancreateoduodenal artery (IPDA) and separate the adhesion between the pancreatic uncinate process and SMA at the back. Subsequently, the pancreas was split cranially in the neck. Using a 60-mm
linear cutter stapler, the proximal jejunum was separated and dragged into the right upper quadrant. The uncinate process was separated from the SMV and SMA during the last stage of the resection. The right posterior "SMA-first" dissection method resulted in a thinner uncinate process. To improve visualization during dissection of the uncinate process, the pancreatic head, duodenum, and SMV were retracted laterally with a 45–60° anticlockwise rotation and medially. The uncinate process was then divided cranially and longitudinally along the right aspect of the SMA. En bloc resection of the specimen was used to clear the right 180° of the SMA, with stenting of the pancreatic duct. The specimen was removed by a 5-cm curved periumbilical incision, and the robotic system was then redocked.

A modified version of Child's approach was used to perform digestive repair. Our center performed a modified double-layer pancreaticojejunostomy using a duct-to-mucosa approach. The pancreatic remnant is 0.5 cm from the edge of the anastomosis and is a continuous suture with 4-0 prolene between the seromuscular layer of the jejunum. It can partially wrap the pancreatic stump after anastomosis. The inner layer is a duct-to-mucosa anastomosis that is sewn from the pancreatic stump edge to the major pancreatic duct (MPD) and jejunum's equivalent point. This technique removes any possible space between the pancreatic remnant and jejunum with improved attachment, preventing tears in the pancreatic duct and parenchyma. Duct-to-mucosa anastomosis frequently required six–eight stitches, and a trans-anastomotic stent was frequently inserted (as shown in figure 2). The common hepatic duct's width determined whether continuous or interrupted sutures were used during an end-to-side hepaticojejunostomy. Using a 60-mm linear cutter stapler (Echelon, Johnson & Johnson), gastrojejunostomy was performed using a side-to-side anastomosis approach between the posterior wall of the stomach and jejunum.

**Data statistics**

The Statistical Product and Service Solutions version 26 program was used to perform statistical analyses. Continuous variables were compared using a two-tailed Student's t-test and expressed as the mean ± standard deviation. Wilcoxon rank-sum test was used for continuous variables that were not normally distributed. Categorical variables are represented as numbers (percentages), and Pearson's χ² test or Fisher's exact test contingency tables were used for comparison. The overall survival between the young and old groups was compared using Kaplan-Meier survival curves, and significance was assessed using the log-rank test. Cox proportional hazards regression and binary logistic regression were used for multivariate analysis. Statistical significance was set at P <0.05.

**Results**

Of the 1110 individuals in this investigation, 106 (9.5%) were in the youngest cohort (age <50), and 1004 (90.5%) were in the more elderly category (age ≥ 50) (Table 1). Regarding gender, BMI, or tumor size, it had no discernible differences in the demographics of any of the groups. On the other hand, more individuals in the younger group (9.4% vs. 38.0%, p < 0.001) were found to have an ASA physical status of ≥ 3. Youths had a lower prevalence of periampullary cancers (32.1% vs. 76.5%, p<0.001) compared to the
old population. However, the incidence of neuroendocrine system malignancies (15.1% vs. 3.6%), as well as hard and pseudopapillary malignancies (9.4% vs. 1.0%), were greater in children. Both pancreatic head periampullary cancer (41.2% vs. 48.4%) and other forms (58.8% vs. 51.6%) of periampullary adenocarcinoma were found in an equivalent amount of people of both ages (p = 0.626). Smoother pancreatic tissue (77.4% vs. 62.5%, p = 0.033) and non-dilated ducts (≤3 mm) were more common in the youngest category (77.4% vs. 46.3%, p < 0.001).

Table 1: The characteristics of individuals undergoing robotic pancreaticoduodenectomy with periampullary malignancies
<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Age &lt; 50 y/o</th>
<th>Age ≥ 50 y/o</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients, n (%)</td>
<td>1110</td>
<td>106 (9.5%)</td>
<td>1004 (90.5%)</td>
<td></td>
</tr>
<tr>
<td>Age, year old</td>
<td></td>
<td></td>
<td></td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Median (range)</td>
<td>67 (13–97)</td>
<td>42 (13–49)</td>
<td>68 (50–97)</td>
<td></td>
</tr>
<tr>
<td>Mean ± SD&lt;sup&gt;a&lt;/sup&gt;</td>
<td>66 ± 12</td>
<td>40 ± 9</td>
<td>69 ± 9</td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td>0.512</td>
</tr>
<tr>
<td>female</td>
<td>518 (46.7%)</td>
<td>54 (50.9%)</td>
<td>464 (46.2%)</td>
<td></td>
</tr>
<tr>
<td>male</td>
<td>592 (53.3%)</td>
<td>52 (49.1%)</td>
<td>540 (53.8%)</td>
<td></td>
</tr>
<tr>
<td>BMI&lt;sup&gt;b&lt;/sup&gt;, kg/m&lt;sup&gt;2&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
<td>0.628</td>
</tr>
<tr>
<td>Median (range)</td>
<td>23.5 (15.4–36.2)</td>
<td>23.1 (16.7–34.1)</td>
<td>23.5 (15.4–36.2)</td>
<td></td>
</tr>
<tr>
<td>Mean ± SD</td>
<td>23.7 ± 3.5</td>
<td>23.9 ± 4.1</td>
<td>23.7 ± 3.4</td>
<td></td>
</tr>
<tr>
<td>ASA&lt;sup&gt;c&lt;/sup&gt; physical status classification</td>
<td></td>
<td></td>
<td></td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>&lt; 3</td>
<td>718 (64.7%)</td>
<td>96 (90.6%)</td>
<td>622 (62.0%)</td>
<td></td>
</tr>
<tr>
<td>≥ 3</td>
<td>392 (35.3%)</td>
<td>10 (9.4%)</td>
<td>382 (38.0%)</td>
<td></td>
</tr>
<tr>
<td>Periampullary lesions</td>
<td></td>
<td></td>
<td></td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Pancreatic head adenocarcinoma</td>
<td>386 (34.8%)</td>
<td>14 (13.2%)</td>
<td>372 (37.1%)</td>
<td></td>
</tr>
<tr>
<td>Ampullary adenocarcinoma</td>
<td>278 (25.0%)</td>
<td>12 (11.3%)</td>
<td>266 (25.5%)</td>
<td></td>
</tr>
<tr>
<td>Distal CBD&lt;sup&gt;d&lt;/sup&gt; adenocarcinoma</td>
<td>86 (7.7%)</td>
<td>0 (0.0%)</td>
<td>86 (8.6%)</td>
<td></td>
</tr>
<tr>
<td>Duodenal adenocarcinoma</td>
<td>52 (4.7%)</td>
<td>8 (7.5%)</td>
<td>44 (4.4%)</td>
<td></td>
</tr>
<tr>
<td>IPMN&lt;sup&gt;e&lt;/sup&gt;</td>
<td>86 (7.7%)</td>
<td>8 (7.5%)</td>
<td>78 (7.8%)</td>
<td></td>
</tr>
<tr>
<td>Neuroendocrine tumor</td>
<td>26 (4.7%)</td>
<td>8 (15.1%)</td>
<td>18 (3.6%)</td>
<td></td>
</tr>
<tr>
<td>Solid and pseudopapillary tumor</td>
<td>20 (1.8%)</td>
<td>10 (9.4%)</td>
<td>10 (1.0%)</td>
<td></td>
</tr>
<tr>
<td>Chronic pancreatitis</td>
<td>16 (2.9%)</td>
<td>5 (9.4%)</td>
<td>11 (2.2%)</td>
<td></td>
</tr>
<tr>
<td>Other malignant tumor</td>
<td>66 (5.9%)</td>
<td>14 (13.2%)</td>
<td>52 (5.2%)</td>
<td></td>
</tr>
<tr>
<td>Other benign tumor</td>
<td>52 (4.7%)</td>
<td>14 (13.2%)</td>
<td>38 (3.8%)</td>
<td></td>
</tr>
<tr>
<td>Periampullary adenocarcinomas</td>
<td></td>
<td></td>
<td></td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Yes</td>
<td>802 (72.3%)</td>
<td>34 (32.1%)</td>
<td>768 (76.5%)</td>
<td></td>
</tr>
</tbody>
</table>
Table 2 demonstrates that there were no significant variations between each of the ages groups' surgical outcomes in terms of the length of the procedure (median, 7.8 vs. 8.3 h; \( p = 0.508 \)), hemorrhage during surgery (median, 100 vs. 160 mL; \( p = 0.681 \)), performing radicality (R0 dissection, 92.5% vs. 85.1%; \( p = 0.217 \)), lymph nodes generated (median, 17 vs. 18; \( p = 0.681 \)), lymph nodes affected (50.0% vs. 56.1%, \( p = 0.798 \)), phase 1 + 2 (58.8% vs. 70.6%, \( p = 0.292 \)), percentage of conversion (5.7 vs. 8.4%, \( p = 0.492 \)), and blood vessel removal rate (3.8% vs. 3.8%, \( p = 0.997 \)). In the youngest cohort, the majority of surgical outcomes were favorable. With a median of 16 days, the LOS of the younger group was lower than that of the older cohort (median of 20 days; \( p = 0.033 \)). Pancreatic head adenocarcinoma (+), morbidity (+), POPF (+), and chyle leakage (+) were revealed to be associated in a multivariate approach using binary logistic regression; nevertheless, aging did not serve as another marker of a prolonged hospitalizations period (PHP) under RPD (Fig. 3).

**Table 2** shows the outcomes of the robotic pancreaticoduodenectomy procedure.
Figure 3 shows a forest diagram of multivariate analysis using a binary logistic regression approach. It shows how different factors were used to predict the length of hospitality (LOH) after a robotic
pancreaticoduodenectomy. prolonged gastric empty (PGE), after-surgery pancreatic fistula (ASPF), confidence interval (CI), and US Association of Anesthesia Professionals (AAP).

The total postoperative deaths remained at 1.5%, with 1.6% in the elderly cohort and no postoperative deaths in the youthful category \( (p = 0.352) \). DGE rates were 4.3% for all individuals: 1.9% for the younger population and 4.6% for the more elderly cohort \( (p = 0.359) \). The total POPF percentage reached 7.9% \( (p = 0.914) \), including 7.5% in the youthful category and 8.0% in the elderly cohort. Furthermore, Table 3 shows that there were no significant variations in postoperative illness, Clavien-Dindo surgical complications, issue seriousness, PPH, chyle leaking, biliary leaks, or infection from wounds among the more youthful and older generations.

**Table 3:** The hazards related to operations after robotic pancreaticoduodenectomy
<table>
<thead>
<tr>
<th></th>
<th>Total</th>
<th>Age &lt; 50 y/o</th>
<th>Age ≥ 50 y/o</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients, n</td>
<td>1110</td>
<td>106 (9.5%)</td>
<td>1004 (90.5%)</td>
<td></td>
</tr>
<tr>
<td>Surgical mortality</td>
<td>16 (1.5%)</td>
<td>0</td>
<td>16 (1.6%)</td>
<td>0.352</td>
</tr>
<tr>
<td>Surgical morbidity</td>
<td>624 (56.2%)</td>
<td>56 (52.8%)</td>
<td>568 (56.6%)</td>
<td>0.601</td>
</tr>
<tr>
<td>Surgical complication</td>
<td>0.888</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clavien–Dindo 0</td>
<td>472 (42.5%)</td>
<td>46 (43.4%)</td>
<td>426 (42.4%)</td>
<td></td>
</tr>
<tr>
<td>Clavien–Dindo I</td>
<td>282 (34.4%)</td>
<td>36 (34.0%)</td>
<td>146 (34.5%)</td>
<td></td>
</tr>
<tr>
<td>Clavien–Dindo II</td>
<td>104 (9.4%)</td>
<td>10 (9.4%)</td>
<td>54 (9.4%)</td>
<td></td>
</tr>
<tr>
<td>Clavien–Dindo III</td>
<td>122 (11.2%)</td>
<td>14 (13.2%)</td>
<td>110 (11.0%)</td>
<td></td>
</tr>
<tr>
<td>Clavien–Dindo IV</td>
<td>10 (0.9%)</td>
<td>0</td>
<td>10 (1.0%)</td>
<td></td>
</tr>
<tr>
<td>Clavien–Dindo V (death)</td>
<td>18 (1.6%)</td>
<td>0</td>
<td>18 (1.8%)</td>
<td></td>
</tr>
<tr>
<td>Severity of complication, n = 319</td>
<td>0.947</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minor (Clavien–Dindo I-II)</td>
<td>486 (76.2%)</td>
<td>46 (76.7%)</td>
<td>440 (76.1%)</td>
<td></td>
</tr>
<tr>
<td>Major (Clavien–Dindo ≥ III)</td>
<td>152 (23.8%)</td>
<td>14 (23.3%)</td>
<td>138 (23.9%)</td>
<td></td>
</tr>
<tr>
<td>POPF&lt;sup&gt;a&lt;/sup&gt; (ISGPF&lt;sup&gt;b&lt;/sup&gt; grade B and C)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall</td>
<td>88 (7.9%)</td>
<td>8 (7.5%)</td>
<td>80 (8.0%)</td>
<td>0.914</td>
</tr>
<tr>
<td>Parenchyma of pancreas</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>soft</td>
<td>74 (10.4%)</td>
<td>8 (9.8%)</td>
<td>66 (10.5%)</td>
<td>0.882</td>
</tr>
<tr>
<td>hard</td>
<td>14 (3.5%)</td>
<td>0</td>
<td>14 (3.7%)</td>
<td>0.496</td>
</tr>
<tr>
<td>Diameter of pancreatic duct</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>non-dilated ≤ 3 mm</td>
<td>60 (11.1%)</td>
<td>8 (9.8%)</td>
<td>52 (11.4%)</td>
<td>0.746</td>
</tr>
<tr>
<td>dilated &gt;3 mm</td>
<td>28 (5.0%)</td>
<td>0</td>
<td>28 (5.3%)</td>
<td>0.415</td>
</tr>
<tr>
<td>DGE&lt;sup&gt;c&lt;/sup&gt; (ISGPS&lt;sup&gt;d&lt;/sup&gt; grade B and C)</td>
<td>48 (4.3%)</td>
<td>2 (1.9%)</td>
<td>46 (4.6%)</td>
<td>0.359</td>
</tr>
<tr>
<td>PPH&lt;sup&gt;e&lt;/sup&gt; (ISGPS&lt;sup&gt;d&lt;/sup&gt; grade B and C)</td>
<td>64 (5.8%)</td>
<td>8 (7.5%)</td>
<td>56 (5.6%)</td>
<td>0.559</td>
</tr>
<tr>
<td>Chyle leakage</td>
<td>280 (25.2%)</td>
<td>28 (26.4%)</td>
<td>252 (25.1%)</td>
<td>0.834</td>
</tr>
<tr>
<td>Bile leakage</td>
<td>20 (1.8%)</td>
<td>2 (1.9%)</td>
<td>18 (1.8%)</td>
<td>0.961</td>
</tr>
<tr>
<td>Wound infection</td>
<td>56 (5.0%)</td>
<td>2 (1.9%)</td>
<td>54 (5.4%)</td>
<td>0.269</td>
</tr>
</tbody>
</table>

<sup>a</sup>POPF: postoperative pancreatic fistula, <sup>b</sup>ISGPF: International Study Group of Pancreatic Fistula; <sup>c</sup>DGE: delayed gastric emptying; <sup>d</sup>ISGPS: International Study Group of Pancreatic Surgery; <sup>e</sup>PPH:
In terms of surviving, Table 4 shows that 48.1% of the population with periampullary adenocarcinomas lived for an average of five years. The more young category's 5-year survival probability for periampullary adenocarcinoma was significantly greater compared with the more elderly category's (76.4% vs. 46.7%, p = 0.047) (Fig. 4). Ampullary and pancreatic head adenocarcinomas had 5-year longevity of 100% and 61.4% (p = 0.159) and 62.5% and 31.4% (p = 0.171), respectively. Regarding the likelihood of survival, overall there had been no apparent distinction across both categories. The Cox proportional hazards regression framework (Fig. 5) demonstrated that inadequate longevity following robotic pancreaticoduodenectomy wasn't significantly predicted by age. On the other hand, late stage 3+4 (+), lymphatic node (LN) involvement (+), and pancreatic head malignancy (+) had been noted.

Table 4: Survival rates following robotic pancreaticoduodenectomy for periampullary adenocarcinomas
<table>
<thead>
<tr>
<th>Periampullary adenocarcinoma</th>
<th>Median, (mon.)</th>
<th>Range, (mon.)</th>
<th>Mean ± SD(^a), (mon.)</th>
<th>1-year survival</th>
<th>3-year survival</th>
<th>5-year survival</th>
<th>(P) value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Overall periampullary</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Total, n = 394</td>
<td>20.4</td>
<td>0.2–107.6</td>
<td>28.7 + 23.3</td>
<td>85.4%</td>
<td>57.1%</td>
<td>48.1%</td>
<td>0.047</td>
</tr>
<tr>
<td>Age &lt; 50 y/o, n = 17</td>
<td>35.3</td>
<td>8.9–82.9</td>
<td>40.1 ± 24.2</td>
<td>100%</td>
<td>76.4%</td>
<td>76.4%</td>
<td></td>
</tr>
<tr>
<td>Age ≥ 50 y/o, n = 377</td>
<td>20.2</td>
<td>0.2–107.6</td>
<td>28.2 ± 23.2</td>
<td>84.7%</td>
<td>56.2%</td>
<td>46.7%</td>
<td></td>
</tr>
<tr>
<td><strong>Pancreatic head</strong></td>
<td></td>
<td></td>
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<tr>
<td>Total, n = 191</td>
<td>16.6</td>
<td>0.8–98.1</td>
<td>23.0 ± 19.8</td>
<td>77.8%</td>
<td>40.4%</td>
<td>32.9%</td>
<td>0.171</td>
</tr>
<tr>
<td>Age &lt; 50 y/o, n = 7</td>
<td>24.6</td>
<td>8.9–67.3</td>
<td>34.4 ± 22.4</td>
<td>100%</td>
<td>62.5%</td>
<td>62.5%</td>
<td></td>
</tr>
<tr>
<td>Age ≥ 50 y/o, n = 184</td>
<td>16.5</td>
<td>0.8–98.1</td>
<td>22.6 ± 19.6</td>
<td>76.9%</td>
<td>39.4%</td>
<td>31.4%</td>
<td></td>
</tr>
<tr>
<td><strong>Ampullary</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Total, n = 136</td>
<td>28.1</td>
<td>0.2–107.6</td>
<td>35.7 ± 26.3</td>
<td>91.3%</td>
<td>73.9%</td>
<td>63.1%</td>
<td>0.159</td>
</tr>
<tr>
<td>Age &lt; 50 y/o, n = 6</td>
<td>43.4</td>
<td>11.7–75.6</td>
<td>41.9 ± 29.0</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>Age ≥ 50 y/o, n = 130</td>
<td>28.1</td>
<td>0.2–107.6</td>
<td>35.7 ± 26.3</td>
<td>90.9%</td>
<td>72.8%</td>
<td>61.4%</td>
<td></td>
</tr>
</tbody>
</table>

\(^a\)SD: standard deviation;

**Discussion**

Given that less than 30% of tumors are projected to arise in young people, pancreatic cancer and its occurrence in younger individuals are less likely to have additional periampullary cancers [19]. This is particularly valid regarding periampullary malignancies such as pancreatic tumors. Cancers in youngsters may not be identical to those that occur in older people with respect to their molecular makeup and tumor biology. Our present knowledge of cancer in this demographic is limited, notwithstanding the ongoing discussion concerning whether or not patients who are younger have less favorable outcomes than patients who are older [2]. The use of MIS is becoming more widespread. However, there wasn't much study done on how early age affects survival and operation following RPD.
In comparison to the older category, periampullary adenocarcinomas were less prevalent in the youthful cohort (32.1% vs. 76.5%). On the other hand, neuroendocrine tumors (15.1% vs. 3.6%), as well as hard and pseudopapillary masses (9.4% vs. 1.0%), were more common in the group that was younger. Mansfield et al. [20] found that the most prevalent postoperative histologic description following pancreaticoduodenectomy in young individuals (≤ 30 years old) was chronic pancreatitis (6, 27.3%), next to substantial pseudopapillary cancers (22.7%) and adenocarcinomas (18.2%). El Nakeeb et al. [1] reported a case series of young adults (less than 35 years old) who had pancreaticoduodenectomy. The most prevalent diagnostic category in this group, according to findings, was adenocarcinoma (41.4%), followed by hard pseudopapillary malignancies (29.3%)

Although the most common diagnoses reported in the literature are inconsistent, solid pseudopapillary tumors have become a common histological diagnosis in young individuals.

Younger people may be more susceptible to pancreatic leakage because they often have a smaller pancreatic duct, a less fibrotic pancreas, and a more normal pancreatic parenchyma. As predicted, the prevalence of non-dilated (<3 mm) pancreatic ducts and soft pancreatic parenchyma was higher in the younger group (77.4% vs. 62.5% and 77.4% vs. 46.3%, respectively). Despite these variations, the younger group did not have an increase in POPF or surgical complications compared with the older group. Furthermore, there was no surgical mortality in the younger group, supporting the findings of other studies [1, 5, 20] that RPD are safe for young patients. Although the youth group in this study had a shorter LOS (median, 16 vs. 20 days), age by itself was not an independent predictor of LOS following multivariate analysis. Most likely, reduced morbidity, lower POPF, and fewer cases of pancreatic head adenocarcinoma contributed to the shorter LOS in younger patients.

There is ongoing discussion regarding the relative aggressiveness of younger versus older patients with pancreatic duct adenocarcinomas [2–5]. Meng et al. [5] found no significant correlation between age and long-term survival in patients with pancreatic and periampullary adenocarcinomas after LPD. Additionally, Yeh et al. [21] demonstrated that statistical longevity after pancreaticoduodenectomy varied among individuals of different ages. Many experts have suggested that elderly people's cancer may be biologically harmless [22, 23]. As such, youthful cancer sufferers are thought to possess less favorable outcomes compared to those who are older [24–27]. Applying propensity score matching, Tang et al. [2] evaluated teens and young adults following a radical removal of pancreatic ductal adenocarcinoma and found that cancer might be more serious in those years. Furthermore, Mansfield et al. [20] discovered that the median survival for those with juvenile adenocarcinoma was 10.2 months, while the same mortality for adult patients was 57.8 months. Contrary to Tang and Mansfield's observations [2, 20], El Nakeeb et al. [1] showed that the median survival of young adult patients with pancreatic cancer was much higher than that of older individuals. For overall periampullary adenocarcinoma in this study, young people did five years better than the older individuals (76.4% vs. 46.7%). While the disparity did not prove statistically important, there was indeed an upward trend favoring greater survival prospects in younger patients in the two different ampullary and pancreatic head adenocarcinoma categories. In the multivariate study, aging did not prove to be a distinct indicator of periampullary adenocarcinoma. This could be a result of...
the smaller number of pancreatic head cancer cases with the presence of lymph nodes in our analysis. Still, drawing obvious inferences was challenging due to the more youthful group's tiny sampling size. Further investigation and larger numbers of samples are needed to confirm these findings and understand the mechanisms behind them.

This research has several restrictions. Initially, older individuals comprised all patients in adulthood, regardless of their general health status or comorbidity. In addition, the insufficient number of samples in this young group limited our ability to fully understand biological aggressiveness and increased the likelihood of statistical mistakes.

In conclusion

RPD is safer for people below 50, and surgery outcomes will be comparable to those in elderly patients. Furthermore, younger individuals with periampullary adenocarcinoma had significantly improved chances of survival than those who were older, despite the fact that the data were not autonomous. These findings support the feasibility and potential benefits of RPD in the pediatric population. A larger number of samples and additional research are needed to confirm these findings and look into the reasons for them.

Declarations

Acknowledgment is not applicable

Ethical approved and consent

All necessary ethical licences were issued by the Zagazig University's ethical board committees (ZUM - IRB#99902792023) with written informed consent. Written informed consent obtained from all patients and the study was conducted in accordance with the Helsinki Declaration

Consent for publication is not applicable

Availability of data and materials: a database is available to the corresponding author. This database is available for review and request. All authors have agreed and shared the database.

Competing interests

The authors declare that they have no competing interests or financial disclosures.

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Authors Affiliation

Hassan A. Saad¹,
Azza Baz²,
Mohamed Riad¹,
Mohamed E Eraky¹,
Ahmed El-Taher¹,
Mohamed I Farid¹,
Khaled Sharaf¹

¹Surgical Department, Faculty of Medicine, Zagazig University, Zagazig City, Sharquia, Egypt.

²Surgical Department, Alahrar Teaching Hospital, Zagazig City, Sharquia, Egypt

Corresponding author: Hassan A. Saad, Telephone: (+20) 01221025689, ORCID:0000-0002-6242-7823. E-mail: ebramos_2010@yahoo.com

Author contributions

HAS, ME: contributed to the conception and design of
MR, AKE: organised the database and performed the statistical analysis.
HAS, KS: wrote sections of the manuscript and prepared tables.
MIF, AB contributed to the manuscript revision.

All authors read, approved, and equally shared the submitted version

Authors information

Authors’ email and billing addresses

Hassan A. Saad: -1
ebramos_2010@yahoo.com

Zagagic City, Sharquia

12 Saad Zagloul, St. Egypt

Corresponding author
Postcode (PC): 44661
01221025689

**Azza Baz-2**
azza.baz55@yahoo.com
Zagagic City, Sharquia, Egypt,
13 Kawmia St.
Post code 55971
01226534689

**Mohamed Riad-3**
yara.yara38@yahoo.com
Zagagagic City, Sharquia, Egypt
,13 orbi st
Post code 55971
01277438642

**Mohamed E Eraky-4**
Moh_eraky2@yahoo.com
52 reiad St.
Post code 55971
01019598000

**Ahmed k El-Taher-5**
ahmedkamal5555@yahoo.com
Zagagic City, Sharquia, Egypt,
13 Kawmia St.
Post code 55971
References


**Figures**
Figure 1

Robotic pancreaticoduodenectomy (RPD) trocar placements R1, the first robotic arm; R2, the second robotic arm; C, the camera port; A, the assistant port; and R3, the third robotic arm.
Figure 2

robotic pancreaticoduodenectomy with stenting
Figure 3

Blot showing multivariate analysis using binary logistic regression.

Figure 4

Actuarial survival curves following robotic pancreaticoduodenectomy for the young (age <50 years) and old (age ≥50 years) groups with periampullary cancer.

Figure 5
survival identify independent prognostic factors. Lymph node: LN.after robotic. pancreaticoduodenectomy, we used the Cox proportional hazards regression model and the forest plot