Hypothesis: Pancreas-sparing duodenectomy (PSD) is a safe and effective operative procedure for patients with nonmalignant duodenal polyps.

Design: Retrospective analysis of outcomes in patients undergoing PSD.

Setting: A tertiary referral center.

Patients: All patients undergoing PSD at the Mayo Clinic, Rochester, Minn. Indications were the presence of numerous duodenal polyps or large, solitary, adenomatous polyps not amenable to endoscopic resection. Dysplasia without frank malignancy was demonstrated in all patients by endoscopic biopsy specimens. Follow-up was complete in all patients.

Main Outcome Measures: Operative feasibility, short- and long-term complications, quality of life, and survival.

Results: Five patients had diffuse polyposis (familial adenomatous polyposis) and 3 had very large periampullary villous adenomas. The mean age of the patients was 54 years (female-male ratio, 3:1). Colectomy preceded PSD in 5 patients (familial adenomatous polyposis); 3 had previous transduodenal excision of adenomas, and 2 had previous resections of desmoid tumors. The mean operating room time was 370 minutes; blood loss, 340 mL; and the length of the hospital stay, 18 days. All specimens showed dysplasia (5 low grade, 3 high grade). There were 5 major complications—3 ampullary leaks that closed spontaneously with drainage, 1 intra-abdominal hemorrhage requiring a second exploratory surgical procedure, and 1 deep wound infection. The mean follow-up was 23 months. All patients experienced weight gain and good performance status. A second endoscopy (performed in 5 patients) demonstrated small polyps in the neoduodenum in 2 patients and tiny anastomotic ulcers in 2 patients. For 1 patient, there were no abnormalities seen on the endoscopy. Two patients have since developed transient bouts of pancreatitis.

Conclusions: Pancreas-sparing duodenectomy, although technically demanding, eliminates the need for pancreatic resection. Pancreas-sparing duodenectomy is associated with good absorptive capacity, weight gain, and quality of life. Furthermore, it may reduce the risk of subsequent malignancy. Long-term surveillance, however, is still required. Pancreas-sparing duodenectomy is contraindicated in the setting of malignancy.

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Duodenal polyposis is an uncommon diagnosis. It occurs in 2 different settings—in patients with familial adenomatous polyposis (FAP) in whom the polyps are often multiple and numerous and in patients with isolated villous tumors in whom the polyps are usually single and large, often centered around the papilla of Vater. In patients with FAP, the incidence of duodenal adenocarcinoma has been calculated to be 200 to 300 times greater than that of the general population.1 Accepting the adenoma-carcinoma sequence, and according to our experience with isolated villous tumors of the duodenum,2 it is clear that these growths have increased malignant potential. For many years, surgical judgment has dictated the need for control of these lesions as a prophylactic measure for duodenal-ampullary carcinoma. Following proctocolectomy for polyposis, duodenal adenocarcinoma is the most common cause of malignancy-associated death in patients with FAP. Specifically, in this latter group of patients, transduodenal excision has been considered good treatment provided that the polyp does not harbor invasive cancer.2,3 Recurrences are more difficult to treat, however, and surgical scarring often precludes a proper anatomical dissection in and around the ampulla of Vater.

Chung et al4 reported, for the first time, the possibility of exciting the duo-
PATIENTS AND METHODS

PATIENTS

All consecutive patients undergoing pancreas-sparing duodenectomy (PSD) were reviewed (August 1, 1996, to March 31, 2001). The indication for this procedure was the presence of polyps in the duodenum, either single or multiple, not amenable to endoscopic or transduodenal excision, according to the individual surgeon’s clinical judgment. All patients underwent preoperative upper gastrointestinal tract endoscopy during which biopsy specimens were obtained, and only patients with a benign histologic condition were considered for PSD. Perioperative factors were recorded. Follow-up was complete, and all have been seen as outpatients postoperatively.

OPERATIVE TECHNIQUE

Initial exploration is performed via a midline incision. Since most patients had previous abdominal operations, extensive adhesiolyis was often necessary. The first step is ruling out the presence of metastatic or invasive duodenal disease, findings that would contraindicate PSD. Careful palpation of the second portion of the duodenum, especially around the ampulla, is critical to identify invasive tumors arising in villous adenomas. A generous Kocher maneuver greatly facilitates this examination. Using spiral computed tomography and endoscopic ultrasonography, preoperative assessment and staging are highly accurate. The jejunum and distal duodenum are then freed as depicted in Figure 1. Desmoid tumors in patients with FAP can preclude PSD by fixation of the small-bowel mesentery, making it impossible to transpose the neoduodenum. A point approximately 10- to 15-cm distal to the ligament of Treitz is chosen for division of the bowel. All the feeding vessels are taken down to the level of the uncinate in the manner performed for a Whipple procedure (Figure 1). Once this is complete, the bowel is transected and the proximal end is transposed posterior to the superior mesenteric vessels to the patient’s right side. Gallstones are more likely to form in the absence of the duodenum because of stasis secondary to cholecystokinin deficiency. A cholecystectomy is performed from the fundus downward leaving a long cystic duct stump for introduction of a Fogarty catheter. The catheter is passed down through the papilla into the duodenum, and the balloon is inflated to avoid accidental slippage of the catheter (Figure 2). This maneuver is important to locate the ampulla while completing the duodenectomy. The dissection continues along the interface of the pancreas and the distal duodenum. All vessels are ligated in continuity. Once the ampulla is reached, dissection of the proximal duodenum cephalad to the ampulla is performed after dividing the duodenum just beyond the pylorus. Usually, we can dissect this area without division of the right gastric vessels; if necessary, however, these too can be ligated. The dissection is continued along the medial side of the first and second portions of the duodenum (Figure 2). When the minor pancreatic duct orifice is identified, it is ligated. After reaching the ampulla from the proximal end, the ampulla is transected while placing the duodenum on tension to the patient’s right. After removal of the specimen, the ampullary margin is submitted for frozen section evaluation. The ampulla is exposed and sphincteroplasty and septoplasty are performed (Figure 3). This maneuver increases the diameter of the ampulla to facilitate a mucosal-to-mucosal anastomosis. Biliary and pancreatic stents are used at the discretion of the surgeon.

The distal end of the jejunum is brought posterior to the superior mesenteric vessels, aligning the neoduodenum with the duodenal stump for an end-to-end anastomosis, which is performed last. It is important to align the jejunum appropriately with the pylorus to avoid torsion of the neoduodenum. The neoduodenum is rotated slightly bringing the ampulla in line with the antimesenteric border of the bowel. As opposed to the procedure described by Chung et al,6 we prefer not to open the jejunum, but rather to create the anastomosis externally, in a similar fashion to the mucosal-to-mucosal pancreaticojejunostomy performed during a Whipple procedure (Figure 4). Using fine (5-0) absorbable interrupted sutures in the posterior layer, the knots are tied on the inside of the anastomosis. The anterior layer is completed in a similar fashion, with the knots tied on the outside. The duodenojejunostomy is performed with a single layer of interrupted 3-0 PDS sutures. Use of a second external layer of nonabsorbable sutures can be added as well. Prior to completion of the second anastomosis the remaining duodenal mucosa is removed in patients with FAP. The anastomosis is performed by suturing the pyloric mucosa to the duodenal seromuscular layer and then the full thickness of the neoduodenal wall. Closed suction drains are placed. A nasogastric tube is positioned in the patient with the tip just distal to the pylorus for 2 to 3 days. Oral intake is resumed after resolution of the postoperative ileus. In the absence of an ampullary fistula, drains are removed prior to discharge from the hospital. Liver function and serum amylase levels are monitored via test results until normal ranges are reached. Endoscopy should be performed at regular intervals.

Table 1 details the demographics of the 8 patients included in this study. The patients’ mean age was 34 years, with a female-male ratio of 3:1. Three patients had very large periampullary villous adenomas, 2 of which had been previously excised. In the 5 patients with FAP, the duodenum was completely carpeted with polyps making local resection impossible. Two of the patients with FAP...
had undergone endoscopic polypectomies and 1 had undergone 2 prior transduodenal polypectomies. Indications for PSD included the presence of numerous polyps or large, solitary, villous adenomas not amenable to endoscopic excision (Figure 5). Malignancy was a contraindication for PSD. In all patients with FAP, colectomy preceded PSD by a mean of 21 years; 3 patients had an ileoanal anastomosis with ileal pouch and 2 others had ileorectal anastomoses (both later converted to ileal pouches). Two patients had prior resections of an intra-abdominal desmoid tumor; 1 had extensive retroperitoneal fibromatosis. The mean operating room time was 370 minutes, with a mean blood loss of 340 mL, and a length of hospital stay of 18 days. All biopsy specimens had evidence of dysplasia (5 low grade, 3 high grade), but no adenocarcinoma was identified (Table 2). There were no perioperative or late deaths.

Five patients had major postoperative complications—3 ampullary leaks requiring prolonged catheter drainage, 1 intra-abdominal hemorrhage requiring a second exploratory surgical procedure, and 1 deep wound infection requiring prolonged use of intravenous antibiotics (Table 2). The patient with hemorrhage underwent a second exploratory surgical procedure 1 day after the initial operation for anemia and hemodynamic instability. Suture ligation of a bleeding vessel along the raw surface of the pancreas was performed. Seven of 8 patients were discharged home receiving oral feedings without enteral or parenteral supplementation or ongoing gastric suction. A single patient required supplemental jejunal tube feedings while his ampullary fistula healed at home. Within 1 month following hospital discharge, the fistula healed and normal oral intake resumed. One patient remained in the hospital for 3 weeks owing to a prolonged ileus most likely secondary to the surgery and

Figure 1. Dissection of the proximal jejunum and distal duodenum beginning 10 cm from the ligament of Treitz.

Figure 2. Completion of the duodenectomy. The duodenum is mobilized from above and below the ampulla of Vater, after proximal and distal transection. Note the presence of a Fogarty catheter in the common bile duct with the balloon inflated in the duodenum. The catheter greatly facilitates the identification of the papilla.

Figure 3. Sphincteroplasty and septoplasty. These 2 procedures increase the size of the ampullary complex, facilitating the posterior anastomosis. CBD indicates common bile duct; PD, pancreaticoduodenectomy.

Figure 4. Ampullary-jejunal anastomosis constructed using the neoduodenum. With the jejunal mesentery positioned posteriorly, the anastomosis is fashioned with interrupted 5-0 absorbable suture. The final steps involve ligation of the accessory duct located anterior and superior to the major papilla and construction of the duodenoejunostomy. For the latter, the duodenal cuff is kept short. A duodenal mucosectomy is performed and the pyloric mucosa is incorporated with the duodenal seromuscular layer in preparation for end-to-end anastomosis.
the patient’s known retroperitoneal fibromatosis and mesenteric desmoid tumors.

Mean patient follow-up was 23 months. All patients experienced subjective weight gain postoperatively and reported a satisfactory performance status (all good to excellent). A second endoscopy was performed in 5 patients, 2 of whom had polyps in the neoduodenum that were treated endoscopically (Figure 6). Tiny anastomotic ulcers were noted in 2 patients and were treated with antisecretory drugs. Two patients developed transient bouts of pancreatitis approximately 1 year after surgery. One patient had similar episodes preoperatively and was treated successfully with balloon dilatation of the pancreatic duct orifice. The other patient was treated with cholecystectomy and temporary pancreatic duct stenting. She recently experienced another episode and was found to have markedly elevated serum triglyceride levels with an essentially normal cholangiogram and pancreaticogram.

**COMMENT**

The first report of PSD was published by Sillin et al in 1984. Eleven years later this same group published their experience in a series of patients, most with FAP. The pancreas was preserved in its entirety (thus avoiding a pancreatic anastomosis) with restoration of a near-normal anatomical configuration of the gastrointestinal tract. This type of reconstruction is generally not used during the performance of a Whipple procedure, because most surgeons feel it is safer to isolate the pancreatic and biliary anastomoses away from the route of food passage, thus avoiding the potentially disastrous occurrence of lateral pancreatic and biliary fistulas in continuity with the gastroduodenojjunostomy. This anatomical configuration, however, has not been a major concern in our series or that of Chung et al. All 3 major ampullary leaks healed with nonoperative conservative management. Although technically demanding, the procedure becomes less so with experience gained.

We consider a single ampullary anastomosis more practical than separate biliary and pancreatic anastomoses. First, after sphincteroplasty, the ampullary orifice is enlarged, facilitating our anastomotic technique. Second, there are only 2 anastomoses, compared with the 3 performed for a Whipple procedure. Although we cannot say that the diameter of this single anastomosis is the same as the sum of separate biliary and pancreatic ducts, it certainly is quicker and more straightforward. If we take into account that pancreatic fistulas occur in about 15% to 30% of patients after Whipple procedures, our fistula rate in this early experience is acceptable. Although the presence of fistulas, mesenteric fibromatosis, and desmoid tumors often delayed resumption of oral intake, no cases of true delayed gastric emptying occurred, a known complication of the Whipple procedure in at least 10% of these patients.

To date, there are not enough data to critically analyze outcomes after PSD. A review by Maher et al evaluated segmental resection of the infra-ampullary duodenum. None of these patients had a duodenal resection proximal to or at the level of the ampulla. Since the report by Chung et al, and discarding the one by Maher et al, there is just 1 reported series of PSD other than our own. Nagai et al reported the cases of 6 patients in whom PSD was performed for a variety of conditions. On careful review, just 1 patient received a true PSD. This patient had a mucosa-associated lymphoid tissue lymphoma of the duodenum, did not have operative complications, and was alive 7 months after undergoing the procedure.

Another potentially useful procedure for benign sessile duodenal polyps is transduodenal excision. This operation had been our first choice for nonmalignant peri-ampullary adenomas and has been proposed as treatment for duodenal polypsis in select patients with FAP. Re-

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**Table 1. Demographics of the Study Population**

<table>
<thead>
<tr>
<th>Patient No./Sex/Age, y</th>
<th>Indication</th>
<th>Previous Polypectomy</th>
<th>Previous Colectomy</th>
<th>Other Previous Operations</th>
<th>Follow-up, mo</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/F/60</td>
<td>FAP</td>
<td>Endoscopic (×9) and transduodenal (×2)</td>
<td>Yes: IRA 33 y before</td>
<td>Desmoid tumor</td>
<td>17</td>
</tr>
<tr>
<td>2/F/49</td>
<td>FAP</td>
<td>No</td>
<td>Yes: IPAA 15 y before</td>
<td>No</td>
<td>36</td>
</tr>
<tr>
<td>3/M/59</td>
<td>FAP</td>
<td>No</td>
<td>Yes: IRA 37 y before</td>
<td>No</td>
<td>24</td>
</tr>
<tr>
<td>4/F/46</td>
<td>FAP</td>
<td>Endoscopic</td>
<td>Yes: IPAA 20 y before</td>
<td>No</td>
<td>18</td>
</tr>
<tr>
<td>5/F/38</td>
<td>FAP</td>
<td>No</td>
<td>Yes: IPAA 5 y before</td>
<td>Desmoid tumor</td>
<td>44</td>
</tr>
<tr>
<td>6/F/57</td>
<td>Large polyp</td>
<td>Transduodenal</td>
<td>No</td>
<td>Small-bowel resection</td>
<td>24</td>
</tr>
<tr>
<td>7/F/70</td>
<td>Large polyp</td>
<td>Transduodenal</td>
<td>No</td>
<td>No</td>
<td>6</td>
</tr>
<tr>
<td>8/M/54</td>
<td>Large polyp</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>12</td>
</tr>
</tbody>
</table>

*FAP indicates familial adenomatous polyposis; IRA, ileorectal anastomosis; and IPAA, ileal pouch-anal anastomosis (ie, an ileoanal anastomosis with ilea pouch).
currence rates have been high and frequently these re-
currences have developed as invasive carcinomas. Penna
et al10 reported the cases of 6 patients with duodenal pol-
yposis in whom this procedure was performed; 2 pa-
tients developed a duodenal fistula (1 requiring rein-
tervention), all 6 patients had recurrence of duodenal polyps,
and in 5 the polyposis was considered severe according
to the criteria of Spigelman et al.11 These results indi-
cate that transduodenal polypectomy is an inadequate sur-
gical treatment for many patients with FAP as all pa-
tients required additional surgical procedures for polyp
clearance. Pancreas-sparing duodenectomy accom-
plishes complete removal of the duodenal mucosa with
an acceptable complication rate in experienced hands.
Among 7 patients undergoing a Whipple procedure in
the series by Penna et al, one had a pancreatic fistula and
the other an intra-abdominal hemorrhage. Penna et al10
concluded that pancreaticoduodenectomy is the best op-
tion despite the fact that PSD was not included in this
experience.

We do not feel that pancreaticoduodenectomy is the
only option for complete excision of duodenal mucosa in
patients with duodenal polyps. All of our patients have had
good outcomes and are satisfied with their long-term re-
sults. Pancreas-sparing duodenectomy is an operation that
can be performed with acceptable morbidity, even follow-
ing extensive previous abdominal operations, including
those involving the duodenum and small-bowel mesen-
tery. Our results support the concept of radical duodenal
mucosectomy to prevent progression to cancer. Longer fol-
low-up, however, is still necessary.

Patients with FAP and multiple duodenal polyps
likely benefit from PSD, as do patients with large, sess-
sile, periampullary, villous adenomas, especially those with
recurrent polyps and those with dysplasia. All patients
should undergo concomitant cholecystectomy to avoid
postoperative gallstone disease and its complications.

Regular follow-up endoscopy is essential for these
patients. Patients with FAP are at risk of developing other
polyps anywhere in the gastrointestinal tract, including
the neoduodenum, as demonstrated by our postopera-
tive endoscopic findings (Figure 6). Lifelong endo-
sopic surveillance should be considered routine for both
patients with and without FAP treated with PSD. The op-
timal frequency of follow-up cannot be determined based
on the limited available data, but should be at least yearly
for the first 2 to 3 years.

Finally, it is important to keep in mind the recent
developments in the preventive therapy of polyp forma-
tion. Cyclooxygenase inhibitors have been tested in the
laboratory with promising results. The rationale for this
therapy is to counteract the effect of prostaglandins, which
are believed to promote tumorigenesis by increasing cel-
lar proliferation and inhibition of apoptosis.12 Follow-
ing the initial experience with sulindac that showed a
moderate response in both formation and growth of pol-
yps in patients with FAP, a new class of drugs has been
recently described that selectively inhibits the inducible
form of the cyclooxygenase 2. These agents have been
shown to reduce polyp numbers in Apc<sup>H9254</sup>
<sup>716</sup> mice.13 Human trials have shown also a significant reduction in
the formation of colorectal polyps in patients with FAP.14
Perhaps this therapy will be implemented to prevent
adenoma formation in the rest of the small bowel after
colectomy and duodenectomy.15

Table 2. Operative Factors and Outcomes

<table>
<thead>
<tr>
<th>Patient No.</th>
<th>EBL, mL</th>
<th>OR Time, min</th>
<th>LOS, d</th>
<th>Major Perioperative Complication</th>
<th>Dysplasia</th>
<th>Performance Status</th>
<th>Follow-up Endoscopy</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>800</td>
<td>350</td>
<td>20</td>
<td>No</td>
<td>High grade</td>
<td>Good</td>
<td>Stenosis ampullary anastomosis†</td>
</tr>
<tr>
<td>2</td>
<td>200</td>
<td>325</td>
<td>12</td>
<td>No</td>
<td>Low grade</td>
<td>Excellent</td>
<td>Small polyps</td>
</tr>
<tr>
<td>3</td>
<td>400</td>
<td>330</td>
<td>12</td>
<td>Intra-abdominal hemorrhage</td>
<td>Low grade</td>
<td>Excellent</td>
<td>Small polyp and small ulcer</td>
</tr>
<tr>
<td>4</td>
<td>200</td>
<td>380</td>
<td>11</td>
<td>No</td>
<td>High grade</td>
<td>Excellent</td>
<td>Small ulcer</td>
</tr>
<tr>
<td>5</td>
<td>100</td>
<td>280</td>
<td>17</td>
<td>Ampullary leak</td>
<td>Low grade</td>
<td>Good</td>
<td>ND</td>
</tr>
<tr>
<td>6</td>
<td>300</td>
<td>300</td>
<td>15</td>
<td>Deep wound infection</td>
<td>High grade</td>
<td>Good</td>
<td>ND</td>
</tr>
<tr>
<td>7</td>
<td>100</td>
<td>400</td>
<td>23</td>
<td>Ampullary leak</td>
<td>Low grade</td>
<td>Excellent</td>
<td>ND</td>
</tr>
<tr>
<td>8</td>
<td>600</td>
<td>600</td>
<td>33</td>
<td>Ampullary leak and delirium</td>
<td>Low grade</td>
<td>Good</td>
<td>ND</td>
</tr>
</tbody>
</table>

*EBL indicates estimated blood loss; OR, operating room; LOS, length of hospital stay; and ND, not done.
†For this patient the pancreatic orifice was dilated endoscopically.
‡This patient’s condition was successfully managed with a temporary pancreatic stent; subsequent endoscopic retrograde cholangiopancreatography showed no abnormality.

This study was presented at the 109th Scientific Session of the Western Surgical Association, San Antonio, Tex, No-
Corresponding author and reprints: Geoffrey B. Thompson, MD, Department of Surgery, Mayo Clinic and Mayo Foundation, 200 First St SW, Rochester, MN 55905 (e-mail: thompson.geoffrey@mayo.edu).

REFERENCES


DISCUSSION

James A. Madura, MD, Indianapolis, Ind: This article in actuality describes a procedure that lies between transduodenal polypectomy and a pancreaticoduodenectomy. The article is nicely done. It is well detailed, and I think, if you need an atlas to do this operation, this will be your guide.

In reviewing the literature, only a scant handful of publications describe experience with this procedure over the past decade, and the use of it is not really clear to me. I have done this for several infrapapillary villous tumors on rare occasions with good success, but it is unusual for us to do so and I have never done a total duodenectomy in this clinical setting.

In the current series of 7 patients, there have been no deaths but significant morbidity, much like that in pancreaticoduodenectomy. From this standpoint it seems to be a little different from a Whipple procedure, except it does preserve the entire pancreas, but is it worth the effort? I think we should keep it in our options, but again, I am unclear as to its application. It is clear that it is not an operation for amateurs.

My questions to you are as follows: You described all of the studies you do before surgery, as well as biopsies. You must rely heavily on your endoscopists. The minute size of biopsy specimens that they get for us makes me wonder a little bit about their reliability. Second, what is the denominator of this group of patients with both sporadic villous adenomas and familial polyposis? I cannot imagine a group being as small as 7 from the Mayo Clinic. Between 1997 and 2001, how many patients had either transduodenal excision or a Whipple procedure for the same conditions? How do you manage the excised tumors intraoperatively once you get them out? Do you get multiple frozen sections, or do you nervously await the permanent sections to come back? I assume that you would be much more aggressive if you had a malignant transformation of one of these polyps.

In 2 of your patients more villous tumors developed in the jejunum or as you refer to it as the neoduodenum. How do you evaluate these people prior to surgery? I know you do duodenal endoscopy and endoscopic ultrasound, but do you have your gastrointestinal endoscopists use a colonoscope to look at the proximal jejunum? What if you saw a number of polyps there that you did not expect, because after all, you stapled off the jejunum before you bring it behind the vessels? Would you do more extensive endoscopy or enteroloscopy to evaluate the proximal jejunum to make sure you are not dealing with more and more polyps in the near future?

Finally, we know that 7% to 10% of the population across the world have pancreas divisum and since you are taking the duodenum off the head of the pancreas, one of these times you are going to have somebody who does have pancreas divisum with dorsal duct dominance. If you found this, what would you do with it? Would you then do 2 anastomoses? Have you considered having an ERCP (endoscopic retrograde cholangiopancreatography) ahead of time? Have you considered doing an intraoperative pancreateogram to assure that you are not going to miss this alternative ductal drainage? I think if you cut across the duct of Santorini and do not recognize it, you will have an end-pancreatic fistula that will not close in 5 days as it did in one of your patients with a presumed minor duct leak did. If you ligate that duct, then I think you are going to end up with a case of necrotizing pancreatitis that could be lethal.

Hung Sy Ho, MD, Sacramento, Calif: I just have a few technical questions. What do you do to the gastroduodenal artery? I assume you preserve it, but you did not mention this. What were the indications for you to abandon the procedure and convert into a Whipple procedure instead? Would you stent the anastomosis and, if you do, which one, the pancreas, the biliary, or both? Lastly, did you ever need to drain the biliary system proximally to prevent the leak at the anastomosis?

Jack Pickleman, MD, Maywood, Ill: Indianapolis and Chicago are close together so we are going to have to stick together on this one. Dr Madura. This is an operation of some virtuosity. I am impressed that you can do it. I am not impressed by the 50% complication rate that is roughly what some people get following Whipple procedures. I am unaware of the disability that arises from removing the head of the pancreas. These people are functionally normal after the Whipple procedure, and there have been some very nice quality-of-life studies that show minimal disturbance in perceived quality of life after a Whipple procedure. So I am sort of wondering if this is not an operation in search of a disease. There is one potential problem if you do this for presumed periampullary villous adenomas. You claim you stage them preoperatively by endoscopic ultrasound, but even in your own previously published report, you missed a couple of those that turned out to be malignant, one of which recurred as an invasive cancer. So I think if you do this operation and you are wrong and it was an invasive cancer, it will clearly be invasive right at your anastomosis and I think you have done that patient a disservice, because I think you would have to go back and do a Whipple procedure at that point. So there may be an indication for this operation in duodenal polyposis. I am not very impressed with it for periampullary adenomas, and I think only the most experienced biliary tract surgeons better try it, because I think you are going to create a lot of deaths with this operation if the average surgeon attempts it.

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Richard C. Thirlby, MD, Seattle, Wash: The title of the article includes the words “Pancreas-Sparing Duodenectomy.” Unless I missed something, you left in part of the duodenum. In my patients with FAP, I have performed standard Whipple procedures and have routinely found polyps up to the pylorus. I would feel uncomfortable leaving in even a centimeter of duodenum.

Claude H. Organ, Jr, MD, Oakland, Calif: Can we assume that none of these were (patients with) Gardner syndrome?

Dr Thompson: Once again I would like to extend my appreciation and thanks to the association for the privilege of presenting our data, and to the discussants for their useful and insightful comments.

All 5 of the patients with multiple polyposis had FAP and not the Gardner variant.

Villous tumors of the duodenum account for most of benign tumors of the duodenum, particularly in the periampullary region. Solitary villous adenomas less than a centimeter in diameter are generally treated by our endoscopists, so the exact number of these neoplasms remains unclear. Based on retrospective data from our institution, looking at operative treatment for villous tumors of the duodenum, I would estimate that we are performing about 3 to 4 operations per year for villous tumors of the duodenum. The vast majority of these are in the periampullary region, and many are associated with FAP. Based on our experience, we no longer advocate transduodenal excision except in the most infirm patients. Transduodenal excision involves a difficult, nonanatomical dissection, within a deep hole. It requires a challenging mucosal-to-mucosal reconstruction. It is associated with a high leakage rate, and most disturbing, a significant recurrence rate, frequently these recurrences recur as invasive carcinoma. Therefore, our practice today for larger periampullary villous tumors or diffuse polyposis is to perform either a Whipple procedure or a PSD with the former being the most common operation performed in more than 60% of our cases today.

Pancreas-sparing duodenectomy has the advantage of allowing for a straightforward, although somewhat tedious, anatomical dissection. I think if you have not done the operation, it is hard to be critical of it. It actually gets easier with experience gained. I think it provides a safer anastomosis, particularly when you are dealing with a bile duct and pancreatic duct that are small in caliber and a pancreas that is soft in consistency.

The site of the ampullary transection provides for a larger-caliber anastomosis to relatively firm ampullary tissue that holds sutures well. The mucosal-to-mucosal reconstruction is much easier than with transduodenal excision and, yes, all of the pancreas is preserved. Dr Pickleman, I am fully aware of the quality-of-life studies that have been done with regard to Whipple procedures (comparing them with cholecystectomy). We have done many Whipple procedures and know that is, indeed, the case. However, there are advantages to preserving all of the pancreas in select patients.

Unlike the usual reconstruction for a Whipple procedure, the straight reconstruction that we perform for PSD allows for better long-term surveillance and therapeutic endoscopic intervention, when it becomes necessary.

In our 7 patients complications were common, and we admit to that, although none of these resulted in long-term morbidity. There is a learning curve and valuable lessons have been learned that can be shared in forums such as ours today. I will discuss some of the lessons that I have learned. The arterial and venous tributaries need to be individually ligated in continuity or oversewn. It is tedious but it must be done. Clips and cautery alone will get you into trouble. The gastroduodenal artery is not divided. When you remove the body's only source of cholecystokinin, namely, the duodenum, you better remove the gallbladder. We learned this the hard way in terms of having to perform an interval cholecystectomy. The minor papilla needs to be identified and ligated. We will discuss this further in a minute.

The ampullary anastomosis is more easily performed from outside the bowel unlike the original description from the Cleveland Clinic. This alleviates the need for yet another potential site of leakage. With experience gained, I believe that the serious morbidity with this operation can be reduced to below that of a Whipple procedure or transduodenal excision.

Dr Madura asked if these little minuscule biopsy specimens are totally reliable as a preoperative indicator of malignancy? Our gastroenterologists inform us that with increasing numbers of biopsy specimens, based on the size and number of polyps, their accuracy improves, but it is not 100%. So what sways me one way or the other to do this operation or not do this operation? The finding of high-grade dysplasia on a preoperative biopsy specimen certainly concerns me and would likely sway me away from performing a PSD, as does an obvious malignant diagnosis. Dilation of the bile duct or pancreatic duct on preoperative imaging, jaundice, bleeding, ulceration of the tumor, profound weight loss, and the intraoperative findings of a firm mass on palpation, serosal puckering, or lymphadenopathy, would certainly sway me away from doing this operation. Frozen section is key to our evaluation of these patients and our decision-making process in the operating room. Our pathologists love PSD specimens because all of the polyps have their orientation maintained and they are willing to work harder, because of our normal practice, to take numerous sections and rapidly process them, thus, providing us with valuable information.

If there is cancer, we move on to a Whipple procedure. If there are varying degrees of dysplasia, I will sample lymph nodes. If there is nothing more than that on frozen section, I will complete the PSD. To date, we have not been burned. We will with increasing numbers.

We take a separate slice from the ampullary transection site. This becomes our first frozen section. If there is any dysplasia on this section, I will perform a Whipple procedure.

Our patients have undergone extended endoscopies and enteroclysis as a rule, and some have had endoscopic ultrasonography. The lesions we showed on the endoscopic slide may represent new lesions occurring in response to a genetic predisposition in a bile-bathed field. This may be a group of patients who could benefit from COX-2 inhibitors to counteract the effect of prostaglandins on tumorogenesis.

Although we often stand at these meetings thinking we know more than everyone else in the room about the subject being presented, the author has learned a valuable lesson from today’s principal discussant, Dr Madura, and I thank him for giving me the opportunity to think about this ahead of time. Ligation of the duct of Santorini in a patient with pancreas divisum could, indeed, be disastrous. We have not obtained routine preoperative ERCP because of concern that even minor pancreatitis caused by the ERCP could interfere with performing this operation. However, in the future, as a result of his comments, I will obtain a magnetic resonance cholangiopancreatogram and, if inconclusive with regard to pancreas divisum, I will obtain an ERCP on the morning of surgery. Finally, if the patient does, indeed, have pancreas divisum, it would be my preference to perform a Whipple procedure rather than add yet another pancreatic duct anastomosis to the operation.

Dr Thirlby's question about the duodenal cuff is a very important one. I leave a very short duodenal cuff and perform a duodenal mucosectomy. I bring the pyloric mucosa down to the cut edge of the seromuscular layer of the duodenum. I then do a single-layer interrupted anastomosis to the neoduodenum. To remove every bit of mucosa at risk in a patient with FAP would require a total gastroenterectomy; this is impractical but with these maneuvers, we are limiting the risk of recurrence as much as possible.