Pancreas-Sparing Duodenectomy for Duodenal Polyposis

Juan M. Sarmiento, MD; Geoffrey B. Thompson, MD; David M. Nagorney, MD; John H. Donohue, MD; Michael B. Farnell, MD

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 a 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. Accepting the adenoma-carcinoma sequence, and according to our experience with isolated villous tumors of the duodenum, 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. 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 al. reported, for the first time, the possibility of excising 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 adhesiolysis 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 plac- ing 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,4 we prefer not to open the jejunum, but rather to create the anastomosis externally, in a similar fashion to the mucosal-to-mucosal pancreatojejunostomy performed during a Whipple procedure5 (Figure 4). Using line 5-0 absorbable interrupted sutures in the posterior layer, the knots are tied on inside of the anastomosis. The anterior layer is completed in a similar fashion, with the knots tied on the outside. The duodenojunostomy 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 54 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

denum, thus preserving the pancreas in its entirety. They emphasized this treatment for patients with FAP, in whom complete clearance of polyps basically required excision of the duodenum. Until then, pancreaticoduodenectomy was the only alternative for patients in whom limited transduodenal or endoscopic excision was not feasible. Since that original report, data remain sparse with regard to the outcome of this procedure. This article reviews our experience in the treatment of these patients at the Mayo Clinic, Rochester, Minn.
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, pancreatectoduodenectomy.

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 duodenojunostomy. 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.

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experience in a series of patients, most with FAP. 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.4 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,7 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.7

To date, there are not enough data to critically analyze outcomes after PSD. A review by Maher et al8 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.8 Since the report by Chung et al,1 and discarding the one by Maher et al, there is just 1 reported series of PSD other than our own. Nagai et al9 reported the cases of 8 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 adenomas10 and has been proposed as treatment for duodenal polyposis in select patients with FAP. Re-

### 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 Follow-up, mo</th>
</tr>
</thead>
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<tr>
<td>1/F/60 FAP Endoscopic (×9) and transduodenal (×2)</td>
<td>Yes: IRA 33 y before</td>
<td>Desmoid tumor</td>
<td>17</td>
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<tr>
<td>2/F/49 FAP No</td>
<td>Yes: IPAA 15 y before</td>
<td>No</td>
<td>36</td>
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<td></td>
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<tr>
<td>4/F/46 FAP Endoscopic</td>
<td>Yes: IPAA 20 y before</td>
<td>No</td>
<td>18</td>
<td></td>
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<tr>
<td>5/F/38 FAP No</td>
<td>Yes: IPAA 5 y before</td>
<td>Desmoid tumor</td>
<td>44</td>
<td></td>
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<td>No</td>
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</tr>
<tr>
<td>8/M/54 Large polyp No</td>
<td>No</td>
<td>No</td>
<td>12</td>
<td></td>
</tr>
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</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 recurrences have developed as invasive carcinomas. Penna et al reported the cases of 6 patients with duodenal polyposis in whom this procedure was performed; 2 patients developed a duodenal fistula (1 requiring reintervention), all 6 patients had recurrence of duodenal polyps, and in 5 the polyposis was considered severe according to the criteria of Spigelman et al. These results indicate that transduodenal polypectomy is an inadequate surgical treatment for many patients with FAP as all patients required additional surgical procedures for polyp clearance. Pancreas-sparing duodenectomy accomplishes 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 al concluded that pancreaticoduodenectomy is the best option 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 results. Pancreas-sparing duodenectomy is an operation that can be performed with acceptable morbidity, even following extensive previous abdominal operations, including those involving the duodenum and small-bowel mesentery. Our results support the concept of radical duodenal mucosectomy to prevent progression to cancer. Longer follow-up, however, is still necessary.

Patients with FAP and multiple duodenal polyps likely benefit from PSD, as do patients with large, sessile, 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 postoperative endoscopic findings (Figure 6). Lifelong endoscopic surveillance should be considered routine for both patients with and without FAP treated with PSD. The optimal 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 formation. 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 cellular proliferation and inhibition of apoptosis. Following the initial experience with sulindac that showed a moderate response in both formation and growth of polyps 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 mice. Human trials have shown also a significant reduction in the formation of colorectal polyps in patients with FAP. Perhaps this therapy will be implemented to prevent adenoma formation in the rest of the small bowel after colectomy and duodenectomy.

This study was presented at the 109th Scientific Session of the Western Surgical Association, San Antonio, Tex, November 14, 2001.
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 in that 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 enterolysis 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 pancreatogram 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 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 not 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 the removal of 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 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.
Richard C. Thrilby, 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 informed 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 of-life studies that have been done with regard to Whipple procedures. Finally, if the patient does, indeed, have pancreas divisum, I will obtain an ERCP on the morning of surgery. Additionally, 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 Thompson: Unless I missed something, you left in part of the duodenal cuff is a very important one. I leave a very short duodenal cuff and I 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.

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