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# Complications after pancreaticoduodenectomy: intraabdominal abscess

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**Abstract**
The development of intraabdominal abscess (IAA) following pancreaticoduodenectomy (PD) is an important problem. It is a common cause of readmission to the hospital following discharge. Rates of IAA do not appear to depend on whether the pancreas is anastomosed to the stomach or jejunum, nor whether a duct-to-mucosa or invagination technique is used. Most surgeons favor the use of closed-suction drains after PD. The use of fibrin glue sealant does not appear to reduce the rate of IAA. The use of preoperative biliary stenting increases wound infection rates, but not IAA rates. The use of internal and external pancreatic duct stents with PD to prevent IAA have yielded mixed results.

**Key words** Intraabdominal abscess · Pancreaticoduodenectomy · Complication

## Introduction

Pancreaticoduodenectomy (PD) is considered a complex surgical procedure that is associated with a relatively high complication rate. It was first successfully performed early in the twentieth century, but was rarely performed before 1935, when Whipple published his classic paper in the *Annals of Surgery*.[1] Subsequently, because of hospital mortality in the range of 25%, PD was performed infrequently until the 1980s, at which time several institutions around the world became interested in this operation. They started attracting large numbers of patients with both malignant and benign disease, and became regional centers of excellence. Institutions performing large volumes of this procedure started reporting their results, with substantially decreased hospital mortality; but morbidity, including postoperative pancreatic fistula, intraabdominal abscess (IAA), and delayed gastric emptying, remains a significant problem.[2–6]

IAA following PD is most likely the consequence of pancreatic fistulae and/or leakage from the pancreatico- or hepatico-intestinal anastomosis. IAAs can also, rarely, be secondary to leakage from the duodeno- or gastrojejunostomy. They are often associated with increased morbidity and even mortality, secondary to sepsis. Intraabdominal fluid collections are common in the early postoperative period and should not be confused with the more serious finding of an abscess, which is manifested by signs of sepsis (fever, chills, malaise, increased abdominal pain, increased white blood cell count, and ileus). Often, benign postoperative fluid collections have thin walls and simple fluid density, and they do not have associated air on imaging. Postoperative IAAs, on the other hand, have thickened walls and complex fluid density, and they frequently have both air and fluid within the cavity. The treatment of choice for larger IAAs (typically greater than 4 or 5 cm) is drainage by percutaneous catheter techniques, in which catheters can be placed under ultrasound or computed tomography guidance. Typically, patients benefit from a course of broadspectrum antibiotics that is tapered once the offending organisms are known. However, once the abscess is adequately drained and any ongoing leak well-controlled and the patient symptomatically improved, the antibiotics may be stopped. Smaller IAAs, especially (less than 4 cm) can be treated with antibiotics without drainage. This approach is typically used if the patient is not significantly ill and/or if the location of the abscess is difficult to approach safely with catheters. If patients do not respond adequately to these initial measures, surgical reintervention may be required for adequate drainage, peritoneal lavage, and placement of sufficient drains. In some circumstances, patients may require completion pancreatectomy, especially if any ongoing pancreatic leakage is deemed life-threatening.

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## Incidence of intraabdominal abscess

The incidence of IAA following PD has been well reported in the literature. Yeo et al.,[7] from Johns Hopkins, reported on 650 consecutive PDs in the 1990s. In this report, the incidence of IAA was 5%. In the same series there was a 14% rate of pancreatic fistula and a 10% rate of wound infection. Cameron et al.,[8] also from Johns Hopkins, reported on 1000 consecutive PDs performed by the first author between 1969 and 2003. In this report, the incidence of IAA was 6%, compared to a pancreatic fistula rate of 12%, and a wound infection rate of 7%. Grobmyer et al.,[9] from Memorial Sloan-Kettering Cancer Center, used a prospective complication grading system and reviewed 204 patients undergoing PD between 2001 and 2003. They reported an IAA rate of 4%, as well as a pancreatic fistula rate of 12%, and a wound infection rate of 11%.

IAA is a significant cause for hospital readmission after discharge. Van Geenen et al.,[10] from Academic Medical Center in Amsterdam, reviewed reasons for readmission after PD. They studied the course of 283 consecutive patients operated upon between 1992 and 1999 and found that 106 (38%) were readmitted. Of this group that was readmitted, 47 (44%) were readmitted for surgical complications such as IAA ($n = 11$), pancreatic fistula ($n = 8$), and gastrointestinal obstruction ($n = 8$).

In another study, Emick et al.,[11] from Johns Hopkins, studied 1643 patients undergoing PDs between 1996 and 2003 and reported that 431 (26%) were readmitted a total of 678 times for a total of 4847 hospital readmission days. They categorized all episodes of readmission as early (<1 year) or late (>1 year). Of all 431 patients who were readmitted, 15% were for IAA. Of the 308 patients who were readmitted within the first year, 19% were for IAA. Of the 123 patients who were readmitted after the first year, 5% were for IAA.

## Pancreatic anastomotic technique

A Japanese survey of 3109 patients, focusing on the methods of pancreaticogastrointestinal anastomosis and postoperative complications associated with PD, was reported by Watanabe et al.[12] In this survey, a broad sampling including 83 institutions was performed. In this population surveyed, there were 102 (3.3%) cases of IAA. The incidence of IAA was 3.4% after pancreaticojejunostomy and 2.7% after pancreaticogastrostomy ($P = 0.50$). Focusing on patients with pancreaticojejunostomy, those who had a duct-to-mucosa anastomosis had an IAA rate of 3.1%, whereas those with a dunking anastomosis had a 4.2% rate ($P = 0.42$).

A randomized controlled trial was reported by Bassi et al.,[13] from the University of Verona, in which 144 subjects who underwent PD and were left with soft remnant glands were randomized to either a duct-to-mucosa pancreaticojejunostomy (group A) or an end-to-side pancreaticojejunostomy encompassing the entire cut surface of the pancreas (group B). The specific IAA rates in the two groups were not delineated, but the pancreatic fistula rates were 13% versus 15%, and the intraabdominal fluid collection rates were 24% and 20% in groups A and B, respectively (both, $P$ = not significant). The authors concluded that there were no major differences in operative risks associated with either technique.

## Intraperitoneal drainage after pancreaticoduodenectomy

Over the past few decades there has been a general trend in the decreased use of intraperitoneal drainage following abdominal surgical procedures. In regards to PD, the great majority of surgeons still employ intraperitoneal drainage after this procedure; however, there are no data that specifically support this. In a randomized controlled trial, Conlon et al.,[14] from Memorial Sloan-Kettering Cancer Center, randomized 179 patients to undergo intraperitoneal drainage with closed-suction drains or none after PD ($n = 139$) or distal pancreatectomy ($n = 40$). The rate of IAA was 6.8% for the drain group and 6.6% for the no-drain group. More importantly, the authors investigated the need for surgical or radiologic intervention in these two groups in the postoperative period. The need to return to the operating room was 9% in the drain group and 4% in the no-drain group, whereas the need for interventional radiologic intervention was 13% in the drain group and 8% in the no-drain group. Although these authors conclude that routine placement of drains is unnecessary, most pancreatic surgeons are uncomfortable in not leaving intraperitoneal drains, especially in a patient with a soft remnant pancreatic gland.

## Timing of drain removal

A prospective study has recently been reported by Kawai et al.,[15] from Wakayama Medical University, in which they studied whether the length of time closed-suction drains were left in place influenced the incidence of postoperative complications, including IAA, after PD. They enrolled 104 consecutive subjects into the study over a 4-year period. During the first 2 years,

52 subjects underwent drain removal on postoperative day (POD) 8 (group 1), and during the last 2 years, 52 subjects underwent drain removal on POD 4 (group 2) if the drainage fluid was clear and there was no evidence of pancreatic leak or bacterial contamination. The study demonstrated a lower rate of pancreatic fistula (3.6%) in group 1 compared to group 2 (23%; $P = 0.0038$). The rate of intraabdominal infections was lower in group 1 (7.7%) compared to group 2 (38%; $P = 0.0003$). Additionally, the rate of infected intraabdominal collection was lower in group 1 (1.9%) compared to group 2 (19%; $P = 0.0079$). Eighteen of the 52 (34.6%) subjects in group 1 required maintenance of intraabdominal drainage beyond 8 days, whereas 2 of the 52 (3.8%) subjects required maintenance of intraabdominal drainage beyond 4 days. Based on these data, the authors concluded that prophylactic drains placed after pancreatic head resection are best removed on POD 4 as compared to POD 8, when clinically possible, to prevent ascending infection.

### Topical fibrin glue sealant

Fibrin glue sealants are tissue adhesives, composed of human fibrinogen and thrombin, that are used for hemostasis, wound closure, and tissue sealing. Several nonrandomized studies have reported that the use of fibrin glue sealant may decrease the incidence of pancreatic fistula (and IAA).[16–19] A randomized controlled trial of the application of fibrin glue sealant in 97 subjects undergoing 30 PDs, 40 pancreaticojejunostomies, 23 left pancreatic resections, and 4 tumor excisions was reported by D'Andrea et al.,[20] from the University of Padua. There were no significant differences between the fibrin glue and no-glue groups in the formation of pancreatic fistula or IAA. A randomized controlled trial of temporary pancreatic duct occlusion with fibrin glue during both PD and distal pancreatectomy, reported by Suc et al.,[21] from the University of Tolouse, indicated no difference between the fibrin glue and no-glue groups in the incidence of pancreatic fistula or other intraabdominal complications.

A randomized controlled trial investigating the effect of topical fibrin glue sealant on the primary postoperative endpoints of pancreatic fistula, total complications, death, and length of hospital stay in 124 subjects undergoing PD with pancreatico-enteric anastomosis, in the setting of a high-risk soft pancreatic gland, was reported by Lillemoe et al.,[22] from Johns Hopkins. The pancreatic fistula rate was 26% in the fibrin-glue group and 30% in the no-glue group, and this difference was not statistically significant. The IAA rate was low in both groups, 0% in the glue group and 2% in the no-glue group.

### Preoperative biliary drainage

Multiple studies have investigated the association between the formation of IAA and preoperative biliary drainage, such as the placement of endoscopic stents. Povoski et al.,[23] from Memorial Sloan-Kettering Cancer Center, studied the relationship between preoperative biliary drainage and the formation of IAA in 240 patients undergoing PD between 1994 and 1997. Of the 240 patients who underwent preoperative biliary drainage, 19% developed an IAA, whereas only 8% of the 114 patients who did not undergo drainage developed this complication ($P = 0.02$).

In contradiction to this, however, Sohn et al.,[24] from Johns Hopkins, reported no difference in IAA in 408 patients who had preoperative stents placed (4%) compared to the 159 patients who did not (6%). They did report a higher pancreatic fistula rate (10% versus 4%) and wound infection rate (10% versus 4%; both $P = 0.02$) in the stented versus unstented groups, respectively. Similarly, Pisters et al.,[25] from M.D. Anderson Cancer Center, reported on the effect of preoperative biliary decompression on PD-associated morbidity in 300 consecutive patients. The rate of IAA in the 207 patients who underwent drainage was 7%, whereas the rate in the 93 patients who were undrained was 11%. In the drained and undrained groups, respectively, the pancreatic fistula rates were 9% versus 10%, and wound infection rates were 13% versus 4%. On multivariate analysis, only the wound infection rates were significantly different. Finally, Hodul et al.,[26] from Loyola University, reported a study of 212 patients presenting with obstructive jaundice who subsequently underwent PD from January 1996 to June 2002. Patients with preoperative biliary stents ($n = 154$) were compared with patients without preoperative drainage ($n = 58$). No differences were found with respect to the incidence of pancreatic fistula (10% versus 14%), or IAA (7% versus 5%), respectively. Wound infection occurred more often in the stented group (8% versus 0%; $P = 0.039$).

### Pancreatic duct stenting

Roder et al.,[27] from the Technical University of Munich, compared the morbidity and mortality rates of 85 consecutive patients who had PD with ($n = 44$) or without ($n = 41$) temporary stented external drainage of the pancreatic duct between 1994 and 1997 in a prospective nonrandomized trial. A pancreatic fistula was diagnosed in 3 of the 44 patients (6.8%) with stents versus 12 of the 41 patients (29.3%) without stents ($P = 0.007$). An IAA was diagnosed in 2% of the patients with stents, versus 24% of the patients without stents ($P =$

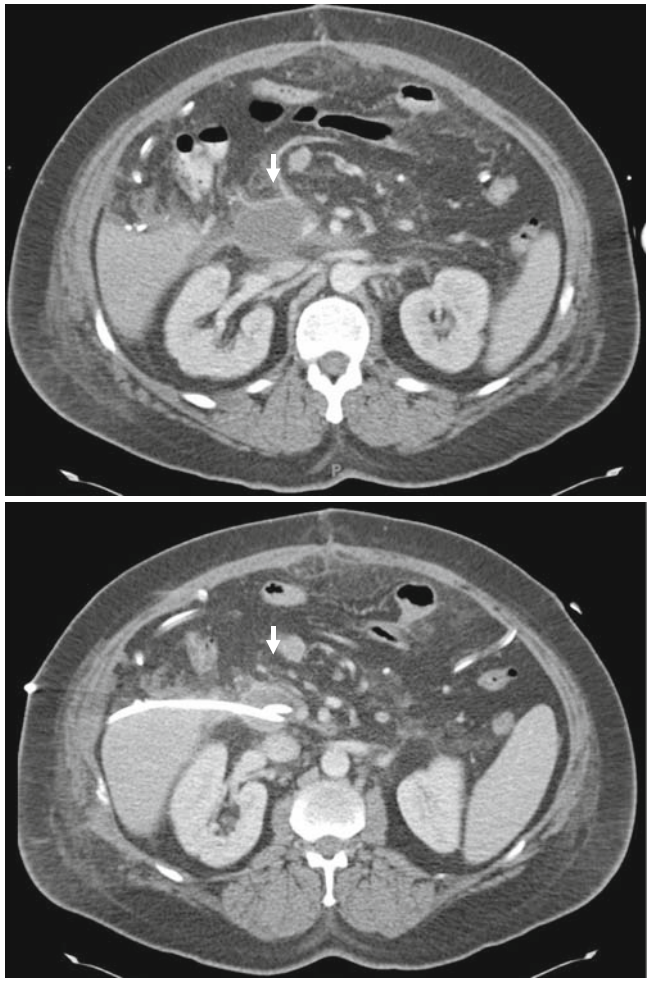

**Fig. 1a,b.** A 46-year-old man underwent a pancreaticoduodenectomy and partial hepatectomy for a pancreatic neuroendocrine tumor of the head of the pancreas with liver metastases. Postoperatively, the patient developed fever, chills, increasing abdominal pain, and an increased white blood cell count. Computerized tomography revealed an intraabdominal abscess in the bed of the resected pancreatic head. **a** Shows a 5-cm abscess (*arrow*) characterized by complex fluid and a thick enhancing rim. **b** Shows the abscess (*arrow*) after placement of a percutaneous drain

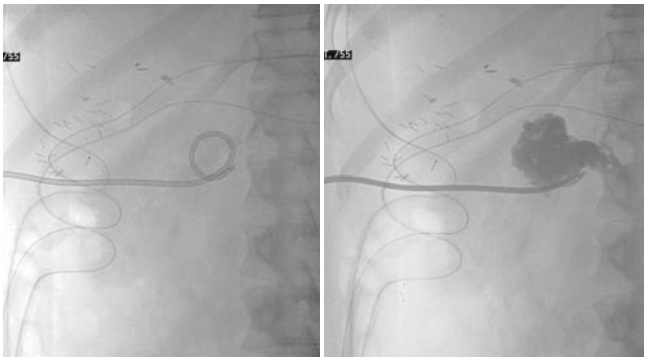

**Fig. 2a,b.** The patient whose scans are shown in Fig. 1 underwent a contrast study of the percutaneous drain; **a** is a scout film before the instillation of contrast, and **b** is the film after the instillation of contrast

0.002). Surgical reintervention was necessary in 1 of the 3 patients with a pancreatic fistula in the stented group and in 3 of the 12 patients with a pancreatic fistula in the nonstented group. There were two deaths after surgery, both in the unstented group. The median hospital stay after surgery was 13 days in the patients with stents and 29 days in the patients without stents.

In contradiction to this, a randomized controlled trial with 238 subjects was performed and reported by Winter et al.,[28] from Johns Hopkins, to test the hypothesis that internal pancreatic duct stenting reduces the development of pancreatic fistula following PD. Patients who were randomized to the stent group had a 6-cm-long segment of a plastic pediatric feeding tube used to stent the pancreaticojejunostomy anastomosis. The IAA, pancreatic fistula, and wound infection rates in the stented and unstented subjects were 7% versus 5%, 11% versus 8%, and 13% versus 19%, respectively. When the authors performed subgroup analysis of the patients with soft pancreas remnants, the IAA, pancreatic fistula, and wound infection rates were 11% versus 4%, 21% versus 11%, and 14 versus 21%, respectively, in the stented versus nonstented groups. None of these differences were statistically significant.

## Conclusions

The development of intraabdominal abscess (IAA) following pancreaticoduodenectomy (PD) remains an important problem and its incidence is in the range of 3%–8%. It is a common cause of the need to be readmitted to the hospital following discharge. There do not seem to be major differences in IAA formation rates based on whether a pancreaticojejunostomy or pancreaticogastrostomy is used, or whether a duct-to-mucosa or invagination of the entire cut surface of the pancreas technique is used. Most surgeons favor the use of closed-suction peritoneal drainage after PD (especially in patients with soft pancreas glands). There has been, however, one randomized controlled trial reported in which the conclusion was that drainage did not appear to help and may even be detrimental. One prospective trial proposed that there may be a benefit to earlier removal of closed-suction drainage when these drains are used in preventing IAA. The use of fibrin glue sealant does not appear to reduce the rate of IAA (nor that of pancreatic fistula) following PD. The use of preoperative biliary stenting appears to increase the postoperative wound infection rate. Some studies dem-

onstrate a decreased rate of IAA with preoperative biliary stenting, but others show no difference. Finally, some groups have tried to decrease the rate of IAA with the use of either external or internal pancreatic duct stents. These results have been mixed, and no strong conclusions can be drawn.

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