Management of Early Hemorrhage from Pancreatic Anastomoses after Pancreaticoduodenectomy

Moritz N. Wente  Shailesh V. Shrikhande  Jörg Kleeff  Michael W. Müller  Carsten N. Gutt  Markus W. Büchler  Helmut Friess
Department of General Surgery, University of Heidelberg, Heidelberg, Germany

interval between primary surgery and relaparotomy was 30.5 h, with a median overall hospital stay of 26.5 days; the 90-day mortality was zero. Based on these results, a step-by-step illustrated approach is described. Conclusions: This uncommon complication of early hemorrhage from pancreaticojejunostomy after pancreaticoduodenectomy can be successfully managed by an enterotomy without endangering the pancreatic anastomosis. By this approach, a completion pancreatectomy may be prevented and the integrity of the anastomosis preserved.

Introduction

Despite tremendous advances that have made pancreatic resectional surgery safer than ever before, pancreaticoduodenectomy remains a major surgical challenge. Thus, while the mortality associated with this procedure has steadily declined during the last decade [1, 2], the morbidity remains high in the range of 25–52%, and this figures apply even to high-volume centers [3, 4]. The major reasons for this morbidity are pancreatic anastomotic leak with fistula, hemorrhage, delayed gastric emptying, and leak from bilidigestive anastomoses with attendant biliary sepsis. With refinements in the technique of pancreatic anastomosis, the occurrence of pancreatic anasto-
Duct leaks has declined remarkably [5, 6], and even in those situations where a fistula does occur, the management is mainly conservative with satisfactory outcomes. However, hemorrhage after pancreaticoduodenectomy can be a serious and life-threatening complication. Postsurgical bleeding complications are reported in 2–16% of the patients following pancreaticoduodenectomy and are associated with high morbidity and mortality. However, the outcomes after management of early hemorrhage from pancreatic anastomosis remain unclear [7–11]. Delayed bleeding after pancreaticoduodenectomy usually occurs later than the 1st week after surgery and is often the result of an erosion of a major blood vessel. While these erosions follow pancreatic anastomotic leak with fistula and local sepsis, early hemorrhage is usually the result of technical failure, as can happen after any major abdominal operation, with resultant severe consequences for the patient. This hemorrhage can be divided into intraluminal bleeding into the gastrointestinal tract and extraluminal bleeding into the peritoneal cavity. Irrespective of the site of the bleeding, the underlying reasons are slipped ligatures, inadequate or incomplete transfixation sutures, wider distance between successive sutures, and smaller blood vessels that tend to spontaneously open up postoperatively once the vasospasm gets relieved which prevents their intraoperative detection during primary surgery.

Based on this, certain open questions arise, particularly with regard to the handling of hemorrhages from the pancreatic anastomosis. Among others, options range from redoing the anastomosis to performing a completion pancreatectomy. However, redoing the pancreatic anastomosis might be demanding, if not impossible, because the jejunal loop is relatively fixed owing to the end-to-side hepaticojunostomy anastomosis, and the gastro- or duodenojunostomy might also make access to the pancreas difficult (fig. 1). In this paper, we attempt to address the problem of early postoperative hemorrhage from pancreaticojunostomy following pancreaticoduodenectomy and describe the experience we gained in the management of this complication. This is a rare complication, and this problem has been sporadically addressed before.

**Fig. 1.** Standard reconstruction method following pylorus-preserving pancreaticoduodenectomy.

**Patients and Methods**

**Patient Characteristics**

Between October 2001 and March 2005, 458 patients underwent pancreaticoduodenectomy in our department and were entered into a prospective database. We performed a search for patients with early intraluminal hemorrhage from the pancreatic anastomosis within the first 72 h following either classical or pylorus-preserving pancreaticoduodenectomy, and this revealed 8 patients (6 male, 2 female) with a median age of 68 (range 33–77) years. Pylorus-preserving and classical pancreaticoduodenectomies were performed in 6 and 2 patients, respectively, with a standardized reconstruction as described before [12]. Four patients underwent pancreaticoduodenectomy for pancreatic ductal adenocarcinoma and 1 each for cystic adenoma, autoimmune pancreatitis, gastrointestinal stromal tumor of the duodenum, and gallbladder cancer (table 1).

**Investigations and Management**

All patients had a marked decrease of hemoglobin during the first 72 h postoperatively with a highest mean value of 10.6 ± 1.5 g/dl and a lowest mean value of 6.7 ± 1.2 g/dl and replacement of a median of 5 (range 4–10) units of packed red blood cells in the interval between pancreaticoduodenectomy and relaparotomy. In 7 patients an upper gastrointestinal endoscopy was performed prior to relaparotomy (table 2).

**Technical Management of Bleeding from Pancreaticojunostomy**

Apart from clinical signs suggestive of postoperative hemorrhage, such as increased pulse rate and progressive hypotension,
fresh blood from the nasogastric tube or, in case the tube has already been removed, hematemesis should alert the surgeon about early intraluminal hemorrhage. Brisk bleeding from the afferent loop of the jejunum on endoscopy nearly confirms that the site of bleeding is from the pancreatic anastomosis. However, diagnostic endoscopy can often fail to reveal the site of bleeding due to blood clots obstructing the jejunal lumen. Here, an assessment of the intra-abdominal drainage output, both in terms of quantity and quality, is critical to reach a clinical bedside decision on whether the hemorrhage is only intraluminal, extraluminal, or both intraluminal and extraluminal. Postoperative bleeding requiring replacement of more than 4 units of packed red blood cells within 24 h almost always requires relaparotomy and control of the bleeding vessel. In case of a pancreaticojejunostomy bleed, the approach has changed; efferent loop and jejunum distal to the gastrojejunostomy or duodenojejunostomy are usually filled with blood, since the stomach also contains clotted blood. Thus, enterotomy of the jejunum with suctioning out blood from stomach, afferent loop, and loop distal to the hepaticojejunostomy is mandatory. If the loop proximal to the hepaticojejunostomy is filling up with blood, it is opened opposite to the site that is anastomosed to the pancreas, so that the entire intact pancreatic anastomosis is exposed for examination and the site of bleeding can be identified (fig. 2) [13, 14]. Fine sutures (e.g., Novafil 5-0) usually suffice to underrun the offending vessel which can be either from the cut surface of the pancreas or from the incision site of the jejunal loop.

As regards details of reexplorations (table 3), in the initial 2 patients the gastrojejunostomy was opened first to exclude bleeding from this anastomosis. Since bleeding continued, the pancre-
aticojejunostomy anastomosis was opened. Arterial bleeding was identified on the surface of the pancreatic remnant, and redoing of the anastomosis was difficult to perform with a high likelihood of anastomotic leakage. Therefore, completion pancreatectomies were performed in both patients. In the 6 other patients, an enterotomy close to the pancreaticojejunostomy (fig. 2), instead of opening the pancreatic anastomosis and adding a possible completion pancreatectomy, was performed; in 4 patients, the arterial bleeding source from the jejunal loop or from the surface of the pancreatic remnant was oversewn. In the remaining 2 patients, gastrotomies and enterotomies with evacuation of blood clots were done, but the exact bleeding source could not be pinpointed; however, the intraoperative scenario was highly suggestive of bleeding from the pancreatic anastomosis.

**Clinical Course**

The relaparotomies in this series of 8 patients with pancreatic anastomotic hemorrhage took place a median of 30.5 h (range 10–67 h) after the initial pancreaticoduodenectomy (table 2), emphasizing the need for careful intensive care monitoring and prompt decision making.

The initial 2 patients who underwent completion pancreatectomy required additional reoperations for abdominal lavage and management of wound dehiscence. They both recovered and were discharged on days 26 and 62 (prolonged intensive care unit stay due to pulmonary complications), respectively, after the primary relaparotomy for early pancreatic anastomotic hemorrhage.

Among the other 6 patients, 1 developed a pancreatic fistula and an intra-abdominal abscess after the first relaparotomy for hemorrhage; he underwent a rerelaparotomy, and a 1-cm defect in the pancreaticojejunostomy was resutured. He made gradual recovery and was discharged on day 52 after the initial relaparotomy. The other 5 patients had an uneventful postoperative recovery after relaparotomies for hemorrhage and were discharged home 11, 15, 18, 21, and 23 days after relaparotomy, respectively.

The overall median hospital stay in all 8 patients with early intraluminal hemorrhage was 26.5 (range 13–68) days. There was no perioperative mortality in this entire series (table 1).

**Discussion**

Early hemorrhage from pancreatic anastomosis after pancreaticoduodenectomy is a serious complication that requires alert and experienced intensive care and surgical teams for optimal management and a successful outcome [7, 15].
Our experience teaches us that early hemorrhage from a pancreaticojejunostomy anastomosis after pancreaticoduodenectomy can be successfully managed by an enterotomy without compromising this crucial anastomosis. If clear established guidelines are followed by the intensive care, endoscopy, radiology, and surgical teams, satisfactory outcomes can be achieved.

In patients with bleeding of the pancreaticojejunostomy, blood clots will obstruct the efferent jejunal loop, leading to intraluminal pressure. This may cause tension on the pancreaticojejunostomy with subsequent leakage, especially in patients with a soft pancreatic remnant. Bearing this in mind, we believe that if pancreaticojejunostomy bleeding is suspected, a reexploration should be indicated at an early stage.

In 2 patients with suspected bleeding at the pancreaticojejunostomy, no active bleeding source was identified during relaparotomy. Furthermore, no further hemorrhage was observed in these 2 patients. There is the chance of spontaneous cessation of an anastomotic bleeding as can also occur in other situations. However, in case of a pancreaticojejunostomy, the texture of the pancreatic remnant determines the stability of the anastomosis; thus in cases with a firm pancreas, in order to give a chance for spontaneous cessation of hemorrhage, the time interval and the number of blood transfusions might be increased prior to subjecting a patient to a relaparotomy.

We recognized that it was a good practice to suck out blood and blood clots from the small intestine via an enterotomy done for the purpose of controlling bleeding from a pancreaticojejunostomy. In all cases, a definite identification of the pancreatic duct was established to avoid inadvertent closure of the main pancreatic duct. Later, a careful tension-free closure of the opened jejunum (after confirmation of good vascularity from the cut margins) was performed to secure this newly created weakness in the wall of the jejunum that now lies opposite to the pancreatic anastomosis. Attention is given to ensure absence of any tension on the pancreatic anastomosis throughout the course of reoperation. Drains were repositioned to ensure adequate drainage and to prevent the development of local septic complications due to subsequent undrained collections. In the individual patient, low-molecular-weight heparin was also discontinued for a period of time.

Vasospasm of unknown small vessels on the pancreatic cut surface that tends to get relieved during the postoperative period with resultant bleeding, a distance of more than 3–4 mm between successive sutures, and a lack of perfect anatomical approximation of the layers of the opened jejunal wall (with a failure to include submucosal layer of the jejunum) are some of the major factors that may cause early hemorrhage from the pancreatic anastomosis. Thus, it appears that a meticulously performed anastomosis should substantially reduce the risk of early hemorrhage from pancreatic anastomosis suture lines.

In addition to the experience of the surgeon in appropriate patient selection and his or her personal technical skills in performing a pancreaticoduodenectomy, better anticipation and management of postoperative complications are essential for improving the results of this operation [16]. To our knowledge and according to a thorough literature search, we noted that while a number of reports described the successful use of embolization techniques in delayed hemorrhage [17–19], none addressed their role specifically in early hemorrhage at the pancreatic anastomosis site. Furthermore, very limited experience is published about the practical management of this specific problem [13–15]. To put the impact of early hemorrhage into perspective: during the same time period, overall 9 patients required reoperation or embolization due to delayed hemorrhage after pancreaticoduodenectomy in our institution.

Thus, while experienced high-volume centers are likely to yield better results in these emergent situations, our experience and approach emphasize that the surgeon remains one of the most, if not the most, important prognostic factors both in prevention and management of early hemorrhage from pancreatic anastomosis after pancreaticoduodenectomy.

Acknowledgements

We would like to thank J. von Bergmann and D. Fischer for preparing the illustrations.
References


