

# World Journal of Trauma and Critical Care Medicine

Review

Open Access

## Management of Arterial Hemorrhage by Pseudoaneurysms Following Pancreaticoduodenectomy

Naoki Hashimoto

Kindai University, School of Medicine

This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/3.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited

### Abstract

Bleeding pseudoaneurysms are among the most serious and fatal complications after pancreaticoduodenectomy. Sentinel bleeding after pancreaticoduodenectomy indicates local sepsis and anastomotic dehiscence. Therefore, I think recognition of the significance of “sentinel bleeding” and prompt response may prevent exsanguination.

Therapeutic embolization should be the initial procedure. This is technically easier for the patient and the surgeon, and there is less chance of rebleeding in septic field.

**Key words:** Pancreaticoduodenectomy, Sentinel bleeding, Pseudoaneurysms, Embolization

### Introduction

Major pancreatic surgery has advanced greatly in the last two decades with a dramatic decrease in its mortality rate. Pancreaticoduodenectomy operated by experienced surgeons is associated with a mortality of less than 5% and significantly reduced morbidity when compared with reports published before 1980 [1, 2]. Pancreatic and biliary fistulas and delayed gastric emptying are the most common complications after pancreaticoduodenectomy. The development and bleeding of visceral arterial pseudoaneurysms are rare phenomena and treatment dilemmas. Delayed hemorrhage, especially from a ruptured pseudoaneurysm, is a rare but rapidly progressing and potential life threatening complication following

pancreaticoduodenectomies. I will make a review to analyze data on delayed hemorrhage after pancreaticoduodenectomy due to pseudoaneurysm rupture.

### Etiology of arterial hemorrhage by pseudoaneurysms

The complication of bleeding occurring through the abdominal drain tract or the gastrointestinal tract after pancreaticoduodenectomy is much less common. Leakage of pancreatic juice and bile, with a resulting fistula and intra-abdominal sepsis, is usually associated with pseudoaneurysm formation. Leak rates from pancreaticoenterostomies for pancreaticoduodenectomy vary from 6% to 24% and occur most often with a soft normal pancreas and a nondilated duct. For the most part, these fistulas are self-limiting and close spontaneously. Less frequently, abscess formation and vessel erosion develop. Brodsky and Turnbull [3] reported a “Sentinel bleeding” after pancreaticoduodenectomy that was attributed to vessel erosion. The vessels

Address for correspondence and reprint requests to: Naoki Hashimoto MD, PhD, Kindai University, School of Medicine 377-2 Ohno-Higashi Osaka-Sayama, Osaka 589-8511 Japan Email: [gojigen000@gmail.com](mailto:gojigen000@gmail.com)  
© 2016 Hashimoto H.O.A et al. Licensee Narain Publishers Pvt. Ltd. (NPPL)

Submitted: Friday, September 16, 2016; Accepted: Tuesday, October 18, 2016; Published Thursday, October 20, 2016

included hepatic, superior mesenteric, splenic, inferior pancreaticoduodenal, short gastric and gastroduodenal arteries. Pseudoaneurysm is a pulsatile hematoma that communicates with an artery via a disruption of the arterial wall. The pathogenesis for pseudoaneurysm formation remains unknown. However, digestion of an arterial vessel wall near a pancreaticojejunal leak by trypsin and elastase is one suggested mechanism. A postoperative intraabdominal hematoma that fails to reabsorb may serve as a nidus for infection near a peripancreatic vessel and form a pseudoaneurysm [4].

Various surgeons have developed different surgical techniques in an attempt to prevent pseudoaneurysm formation. Turrini *et al.*, [5] suggested 1 cm of the gastroduodenal artery stump to minimize direct contact of pancreatic juice adjacent vessels. Koukoutsis *et al.*, [6] suggested spreading an omental flap behind the pancreaticoduodenectomy site.

Sentinel bleeding was first described in 1989 by Shankar and Russel [7]. They defined it as gastrointestinal or intra-abdominal hemorrhage which occurs 6h to 10days prior to massive hemorrhage. Minor sentinel bleeding may herald consecutive devastating arterial bleeding originating from pseudoaneurysms or vascular erosion. In the study by Sato *et al.*, [8], sentinel bleeding was noted in 10 patients with massive arterial hemorrhage out of 81pancreaticoduodenectomy patients and only one case of sentinel bleeding was not followed by massive hemorrhage. In the study by H G Lee [9], sentinel bleeding was evident in 21 of 27 cases (prevalence of 77.8%).

Therefore, it is important to adequately manage sentinel bleeding as soon as possible to prevent massive hemorrhage because sentinel bleeding is an important sign of massive hemorrhage.

### **How are these pseudoaneurysms best managed?**

### **Embolization**

Therapeutic embolization should be the initial procedure. This is technically easier for the patient and the surgeon, and there is less chance of rebleeding in septic field. Transcatheter arterial embolization (TAE) has been proven by many authors to be an efficient and minimal invasive alternative to open surgery [10, 11]. It has a success rate of 67 %-100%, morbidity rate of 14%-25%, and mortality rate of 0%-14%. Lee H G [9] and Martin L [12] reported that stent graft implantation to bridge the bleeding aneurysm led to immediate resolution of the complication. This procedure can be used as an alternative or in addition to embolization [13]. This technique has the advantage of providing continued perfusion to the end-organ and, therefore, obviates the risk of occlusion and ischemia often seen with embolization. In Lee HG's study [9], a stent graft was used for a pseudoaneurysm of the common hepatic artery and superior mesenteric artery to maintain the visceral and liver blood flow. Stent grafting has the advantage of maintaining the peripheral blood flow and hence could be considered an alternative to embolization. However, it is a technically difficult procedure and requires adaptation to different sized vessels.

### **Open surgery**

Brodsky and Turnbull recommend operative exploration in septic patients who are bleeding, our experience has been otherwise. Surgical laparotomy under such circumstances has been extraordinary difficult and hazardous, because of surrounding postsurgical tissue friability. This may lead to inaccurate ligation of a vessel, difficulty in controlling the bleeding or rebleeding because of surround infection. In this serious emergency state, surgery was considered prohibitive because localization and control of the bleeding site would be extremely difficult in a patient status after pancreaticoduodenectomy. Therefore, operative management is limited to patients with hemodynamic instability,

patients with vessels that are difficult or impossible to catheterize, and patients in whom attempted angiographic embolization has failed.

### Conclusions

Bleeding pseudoaneurysms are a rare cause of delayed hemorrhage but these delayed hemorrhage are among the most serious and fatal complication after pancreaticoduodenectomy. Sentinel bleeding is an important sign of massive hemorrhage after pancreaticoduodenectomy. Sentinel bleeding indicates local sepsis and probable anastomotic dehiscence. Therefore, I think recognition of the significance of "sentinel bleeding" and prompt response may prevent exsanguination. Diagnostic angiography has been preferred during sentinel bleeding and is rapidly becoming the standard therapeutic treatment for bleeding pseudoaneurysms.

### Author's contributions

NH: conceived and designed the study, prepared the draft manuscript and edited the manuscript.

### Conflict of Interests

The authors declare that there is no conflict of interests.

### Ethical considerations

Not applicable

### Funding

None declared

### References

1. Grace PA, Pitt HA, Tompkins RK, DenBesten L, Longmire WP Jr. Decreased morbidity and mortality after pancreaticoduodenectomy. *Am J Surg* 1986;151:141-149 [[PubMed](#)].
2. Pellegrini CA, Heck CF, Raper S, Way LW. An analysis of the reduced morbidity and mortality rates after pancreaticoduodenectomy. *Arch surg* 1989;124:778-781 [[PubMed](#)].

3. Brodsky JT, Turnbull AD. Arterial hemorrhage after pancreaticoduodenectomy: the "sentinel bleed". *Arch Surg*. 1991 Aug;126(8):1037-40. [[PubMed](#)].
4. Thakker PV, Gajjar B, Wilkins RA, Levi AJ. Embolization of gastroduodenal artery aneurysms caused by chronic pancreatitis. *Gut* 1983;24:1094-1098 [[PubMed](#)] [[PMC full text](#)]
5. Turrini O, Moutardier V, Guiramand J, Lelong B, Bories E, Sannini A, Magnin V, Viret F, Blache JL, Giovannini M, Delpero JR. Hemorrhage after duodenopancreatectomy: impact of neoadjuvant radiochemotherapy and experience with sentinel bleeding. *World J Surg* 2005; 29(2):212-6. [[PubMed](#)]
6. Koukoutsis I, Bellagamba R, Morris-Stiff G, Wickremesekera S, Coldham C, Wigmore SJ, Mayer AD, Mirza DF, Buckels JA, Bramhall SR. Hemorrhage following pancreaticoduodenectomy: risk factors and the importance of sentinel bleed. *Dig Surg* 2006;23:224-228 [[PubMed](#)].
7. Shanker S, Russel RC. Hemorrhage in pancreatic disease. *Br J Surg* 198;76:863-866 [[PubMed](#)].
8. Sato N, Yamaguchi K, Shimizu S, Morisaki T, Yokohata K, Chijiwa K, Tanaka M. Coil embolization of bleeding visceral pseudoaneurysms following pancreatectomy: the importance of early angiography. *Arch Surg* 1998;133:1099-1102 [[PubMed](#)]
9. Lee HG, Heo JS, Choi SH, Choi DW. Management of bleeding from pseudoaneurysms following pancreaticoduodenectomy *World J Gastroenterology* 2010;14:1239-1244 [[PubMed](#)].
10. De Castro S M, Busch O R, Gouma D J . Management of bleeding and leakage after pancreatic surgery. *Best Pract Res ClinGastroenterol* 2004;18:847-864 [[PubMed](#)]
11. Otah E, Cushin BJ, Rozenblit GN, Neff R, Otah KE, Cooperman AM. Visceral artery pseudoaneurysms following pancreaticoduodenectomy. *Arch Surg* 2002;137:55-59 [[PubMed](#)]
12. Loveček M, Havlík R, Köcher M, Vomáčková K, Neoral C. Pseudoaneurysm of the gastroduodenal artery following pancreatoduodenectomy. Stenting for hemorrhage. *Wideochir Inne Tech Maloinwazyjne*. 2014 Jun;9(2):297-301 [[PubMed](#)] [[PMC fulltext](#)]

13. Blanc T, Cortes A, Goere D, Sibert A, Pessaux P, Belghiti J, Sauvanet A. Hemorrhage after

pancreaticoduodenectomy: when is surgery still indicated? Am J Surg 2007;194:3-9. [\[PubMed\]](#)



**World Journal of Medical and Surgical Case Reports**



**World Journal of Medical Research**

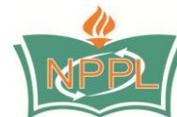


**World Journal of Trauma and Critical Care Medicine**

**World Journal of Surgical, Medical and Radiation Oncology**



**World Journal of Pathology**



Published by **Narain Publishers Pvt. Ltd. (NPPL)**  
The **Open Access** publishers of **peer reviewed** journals. All articles are immediately published online on acceptance.

All articles published by **NPPL** are available **free** online

Authors retain the copyright under the Creative commons attribution license.

The license permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited