ORIGINAL ARTICLE

Bleeding pseudoaneurysms complicating upper abdominal surgery

Hester YS Cheung 張睿珊
CN Tang 鄧宗毅
KH Fung 馮啟雄
Michael KW Li 李家驊

Objective To review the management of ruptured pseudoaneurysms following upper abdominal surgery.

Design Retrospective study.

Setting Minimal access surgery centre, Hong Kong.

Patients Patients who were diagnosed to have a pseudoaneurysm after undergoing major upper abdominal surgery were recruited during the period of 1998 to 2006.

Main outcome measures Success rate of haemostasis, re-bleeding rate, re-intervention rate, and mortality.

Results During the study period, a total of eight patients (median age, 61 years) were managed in our department for bleeding pseudoaneurysms following cholecystectomy, gastrectomy, or Whipple's operation. Five patients underwent upper endoscopy as the initial investigation. In four of these five patients, visceral artery pseudoaneurysms were identified by angiography and haemostasis was achieved without re-bleeding. The one for whom angiographic identification of the bleeding source failed, was successfully treated subsequently by open plication. In three other patients, open surgical haemostasis was resorted to and achieved in two of them. However, one of the latter had re-bleeding, which was successfully treated by embolisation. The one who failed open identification of the bleeding source, was eventually also treated successfully by embolisation. The overall success rates of embolisation and open surgery were 80% and 67%, respectively, and the re-bleeding rates were 0% and 33%, respectively. The corresponding mortality rates were 20% and 33%; both deaths were associated with multi-organ failure. There were no procedure-related complications following embolisation.

Conclusions Based on our experience, visceral angiography can enable the diagnosis and treatment of ruptured pseudoaneurysm in a single session. The procedure is safe, the re-bleeding rate is low, and it is as effective as alternative treatments, and should be considered a first-line intervention in patients with bleeding pseudoaneurysms complicating upper abdominal surgery.

Key words
Angiography; Cholecystectomy; Embolization, therapeutic; Gastrointestinal hemorrhage

Hong Kong Med J 2007;13:449-52

Pamela Youde Nethersole Eastern Hospital, 3 Lok Man Road, Chai Wan, Hong Kong:
Department of Surgery
HYS Cheung, MB, ChB, FRACS
CN Tang, MB, BS, FRCS (Edin)
MKW Li, FRCS (Eng), FRCS (Edin)
Department of Radiology
KH Fung, MB, BS, FRCR

Correspondence to: Dr HYS Cheung
E-mail: yui92549@yahoo.com

Introduction

Bleeding from pseudoaneurysm is an unusual complication that has been reported after laparoscopic cholecystectomy, pancreaticoduodenectomy, and liver transplantation. Patients often present with delayed massive haemorrhage, which can be sudden or intermittent and carries a high mortality. The prediction and treatment for this potentially fatal complication is therefore an important aspect of postoperative management for patients undergoing upper abdominal surgery. Literature review reveals only limited data on its incidence and there is no consensus on optimal treatment options. Traditionally, ruptured pseudoaneurysm is managed by surgical resection and ligation. With advances in technology, newer and less invasive techniques such as transcatheter arterial embolisation (TAE) and endovascular stent grafts have been developed and are reported to be equally safe and effective, especially in high-surgical-risk patients.[1] The aim of this retrospective study was to review our experience on the management of patients with ruptured pseudoaneurysm following upper abdominal surgery and to evaluate the effectiveness of TAE.

上腹部手術併發假性動脈瘤出血

目的 檢討上腹部手術後假性動脈瘤破裂的處理方法。

設計 回顧研究。

安排 香港一所微創手術中心。

患者 在1998至2006年間，接受上腹部手術後診斷出有動脈瘤的病人均為本研究的對象。

主要結果測量 止血的成功率、再出血的比率、再進行治療的比率，以及死亡率。

結果 在研究期內，中心共治理八名分別接受膽囊切除術、胃切除術、Whipple術後，出現假性動脈瘤出血的病人（年齡中位數為61歲）。五位接受胃鏡初步檢查，其中四位通過血管成像發現有內臟假性動脈瘤，止血後無再出血，而餘下一位血管成像無法確定出血源頭的，則施以開放性折疊術成功止血。其他三名病人，當中兩人接受開放性止血手術，成功止血，但其中一人則再出血，後接受栓塞療法而止血。而最後一名用開放式確定方法仍無法確定出血源頭的，亦同樣以栓塞法成功止血。栓塞治療和開放性手術的整體成功率分別為80%及67%，而術後再出血的比率分別為0%及33%，相應的死亡率則分別為20%及33%。兩宗死亡均與多種器官衰竭有關。栓塞術後並無出現與程序相關的併發症。

結論 從經驗所見，腹腔血管成像使診斷和治療假性動脈瘤破裂可以一次完成，過程安全，再出血的機會低，並與其他療法同樣有效，所以應作為治理上腹部手術併發假性動脈瘤出血的首選治療措施。

Methods

This was a retrospective review of hospital medical records, including imaging reports and updated clinical information from out-patient follow-up. The corresponding records referred to all patients diagnosed to have pseudoaneurysms after undergoing major upper abdominal surgery (gastrectomy, cholecystectomy, and Whipple's operation) in the Department of Surgery, Pamela Youde Nethersole Eastern Hospital, Hong Kong between January 1998 and July 2006.

The initial treatment procedure (traditional surgical ligation or TAE, depending on the clinical condition) for the control of the bleeding in each patient was recorded. The outcome parameters evaluated were: success rate of haemostasis, re-bleeding rate, re-intervention rate, and mortality.

The embolisation procedure was standardised. A selective angiogram of the celiac trunk and superior mesenteric artery was performed, using a 5-French pre-shaped Yashiro or Cobra catheter (Terumo, Tokyo, Japan) via a standard transfemoral approach.

Portal vein patency was confirmed from the superior mesenteric angiogram. Once the pseudoaneurysm was identified, superselective cannulation to reach it was performed with a 5-French pre-shaped catheter or an additional microcatheter inserted coaxially within the aforementioned catheter. Embolisation was performed either singly or in combination using stainless steel coils, polyvinyl alcohol sponge (355-550 micron Ivalon), or Gelfoam pellets in the same angiographic session. Complete occlusion of the supplying artery or total exclusion of the pseudoaneursym documented by post-procedure angiography was considered a technical success. Liver function was monitored post-procedure by measuring serum bilirubin and liver enzyme levels.

TABLE 1. Patient characteristics and presentations

Characteristic/presentation	Value
Male:female	6:2
Median age (range) [years]	61 (39-75)
Presentation	
Luminal bleeding	5
Hypotension	2
Intra-abdominal sepsis	1

Results

Characteristics of patients

Over the 8-year period, our department managed a total of eight patients, aged 39 to 75 (median, 61) years, for bleeding pseudoaneurysms following cholecystectomy, gastrectomy, or Whipple's operation. Two of them underwent cholecystectomy (2/2271 patients, 0.1%), two had had a gastrectomy (2/534 patients, 0.4%), and four patients had undergone Whipple's operation (4/67 patients, 6.0%). The time to bleeding ranged from 4 to 150 days after the operation, with a mean of 34 days. Table 1 shows the baseline characteristics of these eight patients and their clinical presentations.

Primary outcome measures

Five patients presented with luminal bleeding and underwent upper endoscopy as the initial investigation followed by angiography. In four of them, visceral artery pseudoaneurysms were identified by angiography, and haemostasis was achieved without re-bleeding. Angiography failed to identify the bleeding source in one patient, as the celiac trunk was not cannulated, so that no obvious contrast extravasation or pseudoaneursym was evident. Subsequent laparotomy identified the bleeding as coming from a pseudoaneurysm of the left hepatic artery and was successfully treated by plication (Table 2).

Two of three patients who underwent open

TABLE 2. Pseudoaneurysm location, diagnostic procedures, and outcomes according to initial treatment*

Location/procedure/outcome	Initial treatment with TAE, n=5	Plication of pseudoaneurysm, n=3
Diagnostic procedures		
Endoscopy	5	0
Ultrasound/computed tomographic scan	0	1
Angiography	5	0
Location of pseudoaneurysm		
Right hepatic artery	2	1
Proper hepatic artery	2	
Right gastric artery		1
Branch of SMA	1	1
Successful haemostasis	4/5 (80%)	2/3 (67%)
Re-bleeding /re-intervention	0	1/3 (33%)
Mortality	1 (20%)	1 (33%)
Median length of hospital stay (range) [days]	67 (7-137)	30 (8-98)

* SMA denotes superior mesenteric artery, and TAE transcatheter arterial embolisation

surgery achieved haemostasis (by ligation), though one of them had re-bleeding that was successfully treated by TAE. In the third patient, haemostasis was achieved following postoperative TAE.

The mortality rates of patients undergoing embolisation and surgical haemostasis were 20% and 33%, respectively. The two patients who died had multi-organ failure, despite successful haemostasis having been achieved.

The median length of hospital stay for patients undergoing initial TAE for haemostasis was 67 days. Furthermore, liver function tests were only transiently deranged after this procedure, and there were no clinical complications such as hepatic infarction or necrosis.

Discussion

Pseudoaneurysms originate from a disruption of arterial wall continuity, resulting in extravasation of blood into the surrounding tissue and formation of a fibrous tissue capsule. It can develop as a result of inflammation, trauma, neoplasm, or surgical procedures.[2] After abdominal surgery, gastro-intestinal bleeding as a result of pseudoaneurysm formation is uncommon, but has a high morbidity and mortality.[3] Hepatobiliary surgery contributes significantly to the occurrence of the hepatic artery pseudoaneurysms. The incidence of hepatic artery pseudoaneurysm is increasing in light of the more radical and aggressive approach to hepatobiliary tumours and transhepatic therapeutic procedures. Rupture may cause bleeding into the peritoneal cavity if the pseudoaneurysm is extra-hepatic, or into the biliary tree (resulting in haemobilia) if it is intrahepatic. Blood may flow into the duodenum directly, masquerading as more typical intestinal bleeding. If the bleeding is slow, blood and bile will not mix because of their different specific gravity and surface tension, leading to the formation of blood clots obstructing the bile ducts. This gives rise to jaundice, cholangitis, and even pancreatitis. Haemobilia can present with abdominal pain (acute bleeding usually first causes pain), upper gastro-intestinal bleeding, and obstructive jaundice,[1] though most patients do not demonstrate the entire triad. Sometimes, the bleeding may be delayed owing to slow expansion of the pseudoaneurysm before rupture.

Although pseudoaneurysms are an important cause of gastro-intestinal bleeding after upper abdominal surgery, exactly how they are formed remains unknown. Three predisposing factors have been identified, namely (a) anastomotic leakage,[4] (b) localised infection and abscess formation after intra-abdominal surgery, and (c) intra-operative arterial injury, especially during lymph node dissection.[5]

Early diagnosis with timely treatment is important to improving prognosis. A falling haemoglobin or persistently low-grade fever in the second or third weeks following surgery should raise the suspicion of local sepsis with the potential for pseudoaneurysm. Most patients experience a septic complication and present with a sentinel bleed before the onset of the more delayed massive haemorrhage, which confers a very high mortality. Patients having postoperative sepsis should be observed with great care. If a minor bleed ensues, the possibility of imminent catastrophic haemorrhage due to pseudoaneurysm formation must be seriously considered.

Despite a high level of clinical vigilance, diagnosis can be particularly difficult. Diagnostic

testing is generally guided by the patient's history and presentation. Upper endoscopy is often employed in those who present with gastro-intestinal bleeding. However, emergency endoscopies under these circumstances may be difficult and unhelpful, depending on the type of reconstruction used for restoration of the gastro-intestinal continuity.[6] Ultrasound and computed tomography may be helpful in identifying postoperative collections, inflammation, intraluminal clots or biliary dilatation, quite apart from providing evidence of bleeding through the pooling of contrast material. However, postoperative sonography may be limited by the presence of surgical wounds and dressings, as well as intra-abdominal gas. In which case, multi-detector row computed tomographic angiography may prove promising for the identification of pseudoaneurysms. In fact, precise identification of the bleeding artery is essential for accurate treatment.

Apart from fluid resuscitation, blood transfusion, and sepsis control with antibiotics, the overall management of postoperative pseudoaneurysm is directed at stopping the bleeding and maintaining continuous biliary flow. Thus, TAE has been widely used and has gained acceptance for the treatment of the visceral pseudoaneurysms in the last decade. Although there was no randomised controlled trial comparing this technique with alternate management strategies (surgery or other transcatheter techniques), it is evident that emergency re-operation in these debilitated and haemodynamically unstable patients carries a high morbidity and mortality. Moreover, the operative failure rate is high, owing to the presence of the associated inflammation, particularly as pseudoaneurysms often result from anastomotic leakage and infection. Anatomical inaccessibility of the bleeding vessel is another problem, especially in patients who have undergone multiple previous operations; prior surgery makes it difficult to dissect tissue planes, owing to the presence of dense adhesions.

It has been reported that up to 95% of such bleeding pseudoaneurysms could be managed and even identified by the embolisation exercise. After visualisation of the bleeding point by superselective arterial catheterization, successful embolisation of the arterial branch proximal to the bleeding point can be carried out either temporarily or permanently (gelatin sponge or microcoils). In case of venous bleeding or an arteriovenous fistula, a covered stent could be deployed. Arterial embolisation has now emerged as a safe and minimally invasive procedure to control bleeding from pseudoaneurysms, with success rates of between 63 and 79%.[3] The present study also demonstrated the safety and efficacy of embolisation; there being no procedure-related complication and a high haemostasis success rate (80%), comparable to what has been reported by others.[7] Furthermore, TAE provides an invaluable adjunct to tackle re-bleeding and treatment failures following surgical ligation, particularly in high-risk patients.

On the other hand, it has also been reported that sometimes, major bleeding cannot be identified during angiography, probably due to its intermittent nature (possibly due to vessel spasm). Thus, some surgeons still recommended immediate laparotomy rather than TAE, aiming to achieve surgical haemostasis and if needed drainage (in the presence of collections or bile duct injuries). In our experience, whenever TAE is possible, it can secure temporary control of bleeding and sometimes permanent haemostasis. After successful TAE, further surgery should also be considered as a definitive treatment for patients with uncontrolled intra-abdominal sepsis or collections.

Conclusions

Based on our experience, visceral angiography can enable the diagnosis and treatment of ruptured pseudoaneurysm in a single session and entails a low re-bleeding rate. It can obviate the need for complex emergency operations in high-surgical-risk patients, which results in lower morbidity and mortality. It is a safe and equally effective alternative to laparotomy. It should be considered as a first-line intervention, whenever there is a high clinical suspicion that a patient has a bleeding pseudoaneurysm complicating upper abdominal surgery.

References

1. Paci E, Antico E, Candelari R. Pseudoaneurysm of the common hepatic artery: treatment with a stent-graft. Cardiovasc Intervent Radiol 2000;23:472-4.
2. Clark ET, Gewertz BL. Pseudoaneurysms. Vascular surgery. 4th ed. Philadelphia: WB Saunders; 1994:1153-61.
3. de Castro SM, Kuhlmann KF, Busch OR, et al. Delayed massive hemorrhage after pancreatic and biliary surgery: embolization or surgery? Ann Surg 2005;241:85-91.
4. Harlaftis NN, Akin JT. Hemobilia from ruptured hepatic artery aneurysm. Report of a case and review of the literature. Am J Surg 1977;133:229-32.
5. Rumstadt B, Schwab M, Korth P, Samman M, Trede M. Hemorrhage after pancreatoduodenectomy. Ann Surg 1998;227:236-41.
6. Porte RJ, Coerkamp EG, Koumans RK. False aneurysm of a hepatic artery branch and a recurrent subphrenic abscess: two unusual complications after laparoscopic cholecystectomy. Surg Endosc 1996;10:161-3.
7. Trede M, Schwall G. The complications of pancreatectomy. Ann Surg 1988;207:39-47.