

가

:

1

. 2 . 3 . . .

: 가

: 1991 1999 가 가 38
. 26 가 , 9

. 4 .

2 가

: 34 가 (89%).

- 26 24 , 9 7
, 4 2 . 7 (18%)
6.4 (0 - 14) . 2

, 2 가

. 3

. 7

6

1

(n = 4),

(n = 3),

(n = 2)

9 (26%) 가

: 가

가

가

가

rial embolization)

가

(3 - 8).

(adventita)

(1).

(2). (splanchnic artery) 가 (3 - 6, 9 - 11). 가

(2 - 4).

. 가 , 가

가

1991 2

1999 11

가

(2 - 5).

42

가

(transcatheter arte -

2

2

38

가 32 , 가 6

55.3

27 80

38

2000 5 24

2000 9 27

가 : 가

가 , 15 (Upjohn, Kalamazoo, Michigan)

24 4 (major bleeding) 13 가

(3). 가 9 가

(sentinel bleeding) . 4 가

(3). 2 가

5F RH catheter 3F Strecker stent (Medi - Tech/Boston Scientific, Natick, MA)

Microferret - 18 infusion catheter (Cook Bloomington, U.S.A.) 가

26 가 (neck) 가

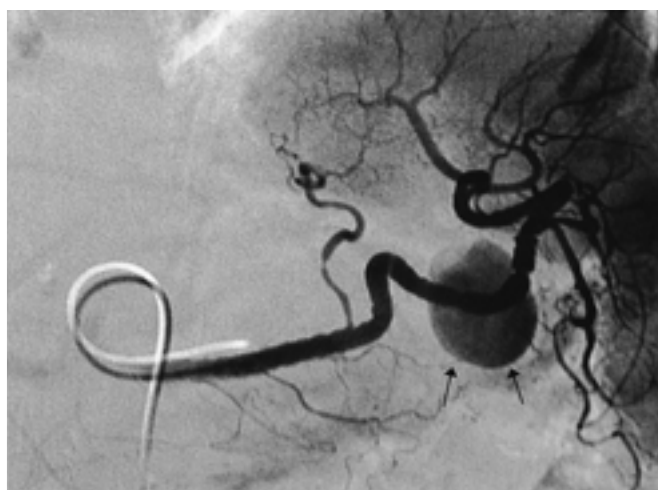
(feeding artery) (moth - er artery)

(Hilal coil, Tornado coil; Cook, Bloomington, U.S.A.) 가

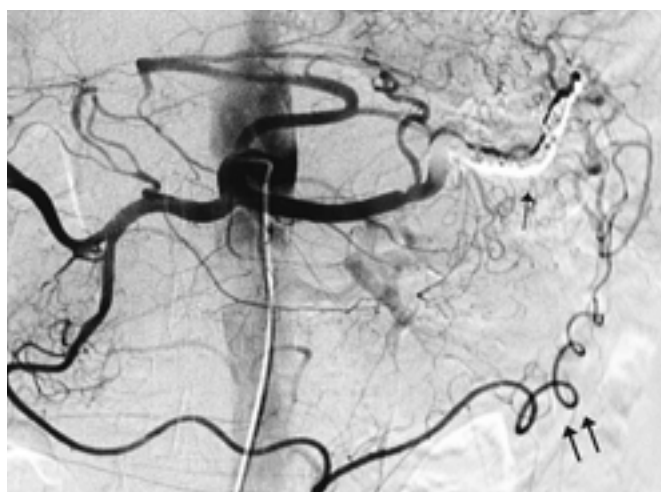
(Table 1).



A



B



C

Fig. 1. Pseudoaneurysm following pancreatitis in a 58 year-old man.

A. Contrast enhanced CT scan shows a pseudoaneurysm (arrow) with partial thrombus at the distal splenic artery.

B. Splenic arteriogram shows a large pseudoaneurysm (arrow) at the distal portion of the splenic artery.

C. After coil embolization of splenic artery from distal to proximal portion of the neck of pseudoaneurysm, no residual contrast filling was seen (arrow). Note the collateral circulation of spleen via right gastroepiploic artery (thick double arrows).

Table 1. Summary of Clinical and Radiologic Data and Outcome of Embolization

	Clinical symptom	Cause	Interval*	Location	Treatment	Outcome	Morbidity
(70/F)	Hemobilia(m) ⁺	PTBD	18	IHA [†]	P/D [§] (Coil&Gelfoam)	Control	None
(77/M)	Hemobilia(M) ⁺	PTBD	3	IHA	P/D (Coil&Gelfoam)	Control	None
(67/F)	Hemoperitoneum(M)	PTBD	8	IHA	P/D (Coil&Gelfoam)	Control	None
(67/M)	Hemobilia(M)	PTBD	20	IHA	P (Gelfoam)	Control	None
(54/M)	Hemobilia(m)	PTBD	5	IHA	P/D (Coil&Gelfoam)	Control	Liver infarct, ARF
(60/M)	Hemobilia(m)	PTBD	20	IHA	P/D (Coil&Gelfoam)	Control	None
(52/M)	Hemobilia(M)	PTBD	2	IHA	P [§] (Coil), Gelfoam 1 st [¶]	Control	None
(46/M)	Hemobilia(m)	PTBD	8	IHA	P (Coil), Gelfoam 1 st	Control	Liver ischemia
(36/M)	Hemobilia(M)	PTBD	19	IHA	P (Coil)	Control	ARF
(70/M)	Hemobilia(m)	PTBD	4	IHA	P (Coil)	Control	Liver abscess**
(73/M)	Hematemesis(M)	HPD ^{††}	46	EHA ^{‡‡}	P/D (Coil)	Control	None
(61/M)	Hematemesis(M)	HPD	10	CHA ^{§§}	P/D (Coil&Gelfoam)	Fail	Death
(45/M)	Melena(M)	PPPD	27	CHA	P/D (Coil)	Control	Liver ischemia
(74/M)	Bloody drain(m)	PPPD	15	EHA	P/D (Coil), Packing 1 st [¶]	Control	None
(56/M)	Hematemesis(M)	PPPD	28	PHA ^{¶¶} , IPDA ^{***}	P/D (Coil)	Control	None
(48/F)	Incidental finding	Total Pan ^{†††}	11	PHA, GDA st ^{‡‡‡}	P/D (Coil)	Control	Liver ischemia
(68/M)	Hematemesis(M)	Whipple 's ^{§§§}	60	SMA, GDA st	Strecker stent & Coil	Control	Death d/t re-bleeding
(50/M)	Hematochezia(M)	Whipple 's	22	Celiac trunk	P/D (Coil&Gelfoam)	Control	None
(56/F)	Hematochezia(M)	Whipple 's	15	CHA, GDA	P/D (Coil)	Control	None
(43/M)	Hematemesis(M)	Whipple 's	24	CHA, GDA, IHA	P/D (Coil)	Control	Liver infarction
(56/F)	Hematochezia(M)	Pancreatitis	59	SMA, IMA ^{¶¶¶}	P (Gelfoam)	Control	None
(42/M)	Hematochezia(M)	Pancreatitis	28	Splenic A	P/D (Coil)	Control	None
(69/F)	Hematemesis(m)	Pancreatitis	58	SMA br	P (Coil)	Control	None
(58/M)	Epigastric pain	Pancreatitis	14	Splenic A	P/D (Coil)	Control	None
(42/M)	Internal bleeding(M)	Blunt trauma	1	Splenic A	P/D (Coil&Gelfoam)	Control	Death d/t shock
(80/M)	Hematuria(m)	Blunt trauma	18	Renal A	P (Coil)	Control	None
(27/M)	Hematemesis(M)	Blunt trauma	34	RGEPA ^{****}	P/D (Coil&Gelfoam)	Control	None
(27/M)	Hematochezia(M)	Blunt trauma	5	AIPDA ^{††††}	P/D (Coil)	Control	Death d/t ARDS
(27/M)	Incidental finding	Blunt trauma	23	IHA	P (Coil)	Control	None
(33/F)	Hematochezia(M)	RT, 5000rad	75	SHA, IIA ^{††††}	P/D (Coil&Gelfoam)	Control	Death d/t ARDS
(66/M)	Hematochezia(M)	Colostomy, HJ	27	IHA, IPA, IAA ^{§§§§}	P/D (Coil&Gelfoam)	Control	Liver ischemia
(60/M)	Hematemesis(M)	Pal GJS	367	RGEPA	P/D (Coil&Gelfoam)	Control	None
(39/M)	Hematemesis(M)	Pal GJS	12	RGA	P/D (Coil&Gelfoam)	Control	Death d/t sepsis
(68/M)	Bloody drain(m)	Hepatectomy	11	CHA, IPA	P (Coil)	Fail	Death d/t bleeding
(43/M)	Melena(M)	Postoperative	14	LGA	P/D (Coil&Gelfoam)	Control	Distal emboli
(69/M)	Melena(M)	Gastrectomy	35	Celiac trunk	P/D (Coil)	Fail	Death d/t bleeding
(72/M)	Melena(M)	Gastrectomy	56	AIPDA	P/D (Coil&Gelfoam)	Control	None
(61/M)	Bloody drain(M)	Tumorectomy	7	acc. RHA ^{¶¶¶¶}	P (Coil&Gelfoam)	Fail	Death d/t bleeding

* (Interval): Interval (day) between angiography and predisposing cause

[†] (M) ⁺ or (m) [†]: Major or minor bleeding[‡] (IHA): Intra-hepatic artery[§] (P/D), (P): Proximal and distal embolization to the neck of pseudoaneurysm, Proximal to the neck of pseudoaneurysm
(ARF): Acute renal failure[¶] (Gelfoam 1st) or (Packing 1st): Re-bleeding after initial Gelfoam embolization or Packing of coil to sac of pseudoaneurysm

** (Liver abscess): death due to liver abscess with sepsis

^{††} (HPD): Hepaticopancreatoduodenectomy^{‡‡} (EHA): Extra-hepatic artery.^{§§} (CHA): Common hepatic artery

(PPPD): Pylorus preserving pancreaticoduodenectomy

^{¶¶} (PHA): Proper hepatic artery^{***} (IPDA): Inferior pancreaticoduodenal artery.^{†††} (Total pan): Total pancreatectomy^{‡‡‡} (GDA st): Gastroduodenal artery stump^{§§§} (Whipple 's): Whipple 's pancreaticoduodenectomy

(SMA) : Proximal portion of superior mesenteric artery

^{¶¶¶} (IMA): Inferior mesenteric artery^{****} (RGEPA): Right gastroepiploic artery^{††††} (AIPDA): Anterior inferior pancreaticoduodenal artery^{‡‡‡‡} (SHA, IIA): Superior hemorrhoidal artery/ internal iliac artery^{§§§§} (IHA, IPA, IAA): Intra-hepatic artery, inferior phrenic artery, and inferior adrenal artery

(Pal GJS): Palliative gastrojejunostomy due to malignancy

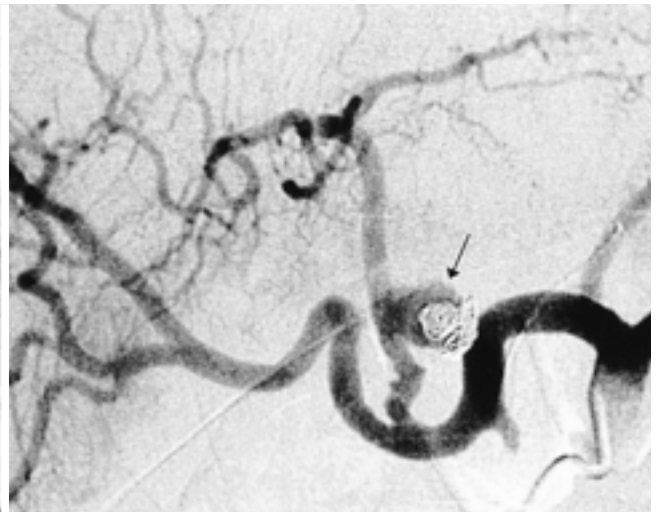
^{¶¶¶¶} (acc RHA): Accessory right hepatic artery

53 가 가 , 7 2 가
가, 3 3 가 . 2
가 (n = 1),
(n = 8) (n = 1) . 가
가
(Fig. 1).
38 34 (89%)
4 24
가 26
24 (92%) . 2
. 가
9 7 (78%)
. 가
4 2 (50%)

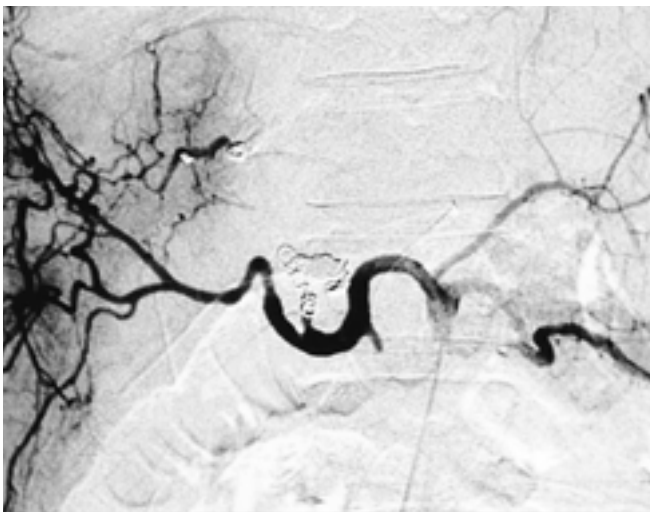
: 가
. 가
2 가
7/38 (18%) 6.4 (0 -
14) 4
2
가
1 (Fig. 2). 가
가 1 가
. 3 가
가
- -



A



B



C

Fig. 2. Re-bleeding after coil packing to the sac of pseudoaneurysm in a 74 year-old-man.
A. Celiac arteriogram shows a pseudoaneurysm at the left hepatic artery following pylorus preserving pancreaticoduodenectomy. Initially, coil packing to the sac of pseudoaneurysm (arrow) was attempted.
B. Celiac arteriogram performed on next day shows enlargement of aneurysmal sac and contrast material filling (arrow).
C. Bleeding was completely controlled by coil embolization of left hepatic artery crossing the neck of pseudoaneurysm.

(Fig. 3).

ing)

5.7

129.7

35

1407

. 가

가

가

3

. 38

24 (63%)
(major bleed -

1

367

31.8

10

6

(60%)



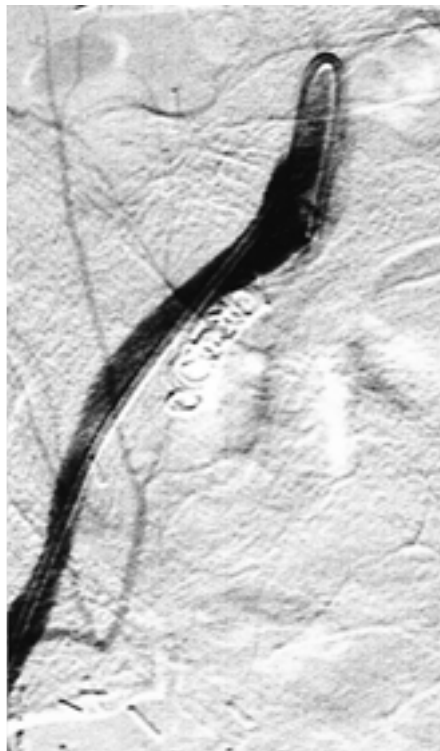
A



B



C



D

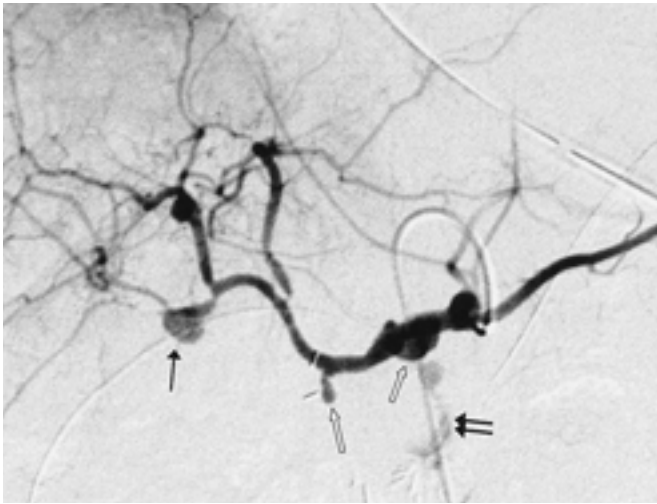
Fig. 3. Multiple pseudoaneurysm following radiation therapy in a 33 year-old woman with uterine cervix cancer.

A. Inferior mesenteric arteriogram shows pseudoaneurysm (arrow) with contrast extravasation at the superior hemorrhoidal artery.

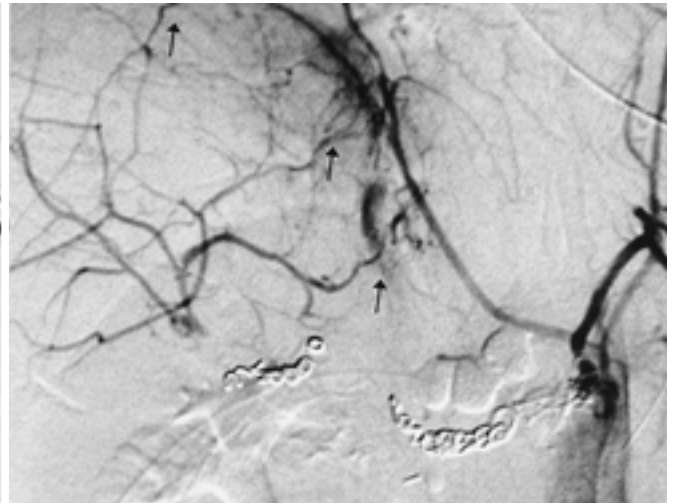
B. Successful bleeding control was obtained by coil embolization.

C. Hematochezia recurred on the eleventh day after initial coil embolization. Right internal iliac arteriogram shows two ruptured pseudoaneurysm at the branch of proximal internal iliac artery (thick arrows).

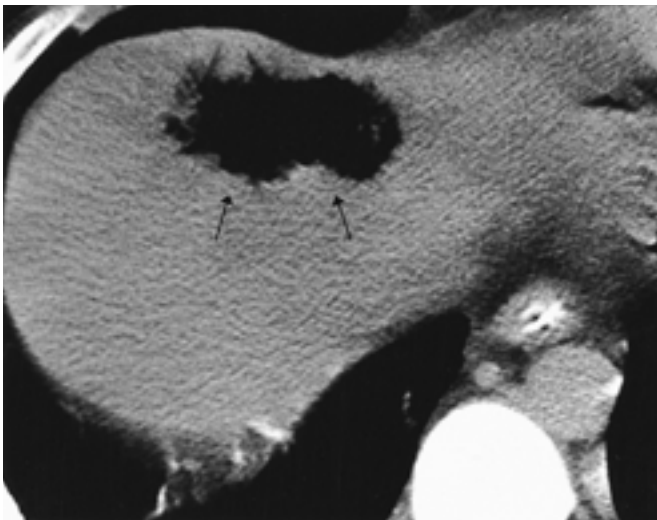
D. The pseudoaneurysms were completely isolated from parent artery by proximal and distal coil embolization cross the neck of aneurysm.



A



B



C

Fig. 4. Liver infarction following coil embolization of pseudoaneurysm in a 56 year-old man.

A. Celiac angiogram shows multiple pseudoaneurysms at the common hepatic artery (short open arrow), gastroduodenal artery stump (long open arrow), and right intrahepatic artery (thin arrow). Also contrast material leakage from pseudoaneurysm of common hepatic artery was seen (double arrow).

B. After coil embolization, there were no visible aneurysm sac, and intrahepatic arteries were opacified via collateral route of inferior phrenic (arrows).

C. Non-enhanced CT scan shows intrahepatic gas collection (arrows) suggesting liver infarction.

10 5 5

가 (n = 4), 9/34 (26%) (n = 3), (3, 5, 12).

(multi - organ failure) (n = 2)

9/38 (24%) 가 (n = 3), (n = 2), (4).

4), (n = 2), (n = 1), 100%, (63 -

(n = 1), (3 - 6, 9 - 11). (0 - 13%)

가 가

가 가 (4, 6, 8, 13 - 15).

(16 - 50%) 가

(4, 6, 7, 8).

92% 가

가 Sidhu (16) 78% 75 - 80%

가 가

(16).

가 가

가 가 (2, 3).

가 가 (12).

가 2

가 가 (19). 3

가 가 2

가 가 , 1

가 가

가 가

가 가

(57 - 75%) 가 가

가 (7, 9 - 11). 가

4 2 (50%) 가

가 가

7 (18%) 가

가 가

(3, 7, 10, 11, 17). 가 4

가 3 10

가 2 가 가

가 가

가 가

가 가

(18). 가

(target organ)

가가

가

가 가 2

가 1

- Frederick JS. Blood vessels. In Cotran RS, Kumar V, Robbins SL, Frederick JS. Pathologic basis of disease. Philadelphia, Saunders 1994;499
- Reber PU, Baer HU, Patel AG, Wildi S, Triller J, Buchler MW. Superselective microcoil embolization: treatment of choice in high-risk patients with extrahepatic pseudoaneurysms of the hepatic arteries. J Am Coll Surg 1998;186:325-330
- Sato N, Yamaguchi K, Morisaki T, et al. Coil embolization of bleeding visceral pseudoaneurysm following pancreatotomy. Arch Surg 1998;133:1099-1102
- Baker KS, Tisnado J, Cho SR, Beachley MC. Splanchnic artery aneurysms and pseudoaneurysms: transcatheter embolization. Radiology 1987;163:135-139
- Reber PU, Baer HU, Patel AG, Triller J, Buchler MW. Life-threatening upper gastrointestinal tract bleeding caused by ruptured extrahepatic pseudoaneurysm after pancreaticoduodenectomy. Surgery 1998;124:114-115
- Chiang KS, Johnson CM, McKusick MA, Maus TP, Stanson AW. Management of inferior pancreaticoduodenal artery aneurysms: a 4-year, single center experience. Cardiovasc Intervent Radiol 1994;17:217-221
- Okazaki M, Ono H, Higashihara H, et al. Angiographic management of massive hemobilia due to iatrogenic trauma. Gastrointest Radiol 1991; 16:205-211
- Blomley MJ, Jackson JE, Case report: a gastroduodenal artery pseudoaneurysm presenting with obstructive jaundice and treated by arterial embolization. Clin Radiology 1994;49:715-718
- McDermott VG, Shlansky-Goldberg R, Cope C. Endovascular management of splenic artery aneurysms and pseudoaneurysms.

- Cardiovasc Intervent Radiol* 1994;17:179-184
10. Golzarian J, Nicaise N, Deviere J, et al. Transcatheter embolization of pseudoaneurysms complicating pancreatitis. *Cardiovasc Intervent Radiol* 1997;20:435-440
 11. Okazaki M, Higashihara H, Ono H, Koganemaru F, Hoashi T, Inada S, Kuroda Y. Percutaneous embolization of ruptured splanchnic artery pseudoaneurysms. *Acta Radiol* 1991;32:349-354
 12. Rivitz SM, Waltman AC, Kelsey PB. Embolization of a hepatic artery pseudoaneurysm following laparoscopic cholecystectomy. *Cardiovasc Intervent Radiol* 1996;19:43-46
 13. LiPuma JP, Sachs PB, Sands MJ, Stuhlmiller S, Herbener TE. Angiography/interventional case of the day. *AJR Am J Roentgenol* 1997;169:258, 258-265
 14. Winick AB, Malloy PC, Lund GB. Retained contrast after embolization of a right gastric artery pseudoaneurysm. *Cardiovasc Intervent Radiol* 1996;19:110-112
 15. Abbott GT, McDermott VG, Smith TP. Successful endovascular treatment of a celiac artery pseudoaneurysm complicating pancreatitis. *J Vasc Interv Radiol* 1996;7:103-106
 16. Sidhu MK, Shaw DWW, Daly CP, Waldhausen JH, Coldwell D. Post-traumatic hepatic pseudoaneurysms in children. *Pediatric Radiology* 1999;29:46-52
 17. Boudghene F, L Hermine C, Bigot JM. Arterial complications of pancreatitis: diagnostic and therapeutic aspects in 104 cases. *J Vasc Interv Radiol* 1993;4:551-558
 18. Cho KJ. *Embolization: principles, techniques and materials*. In Man Chung Han, M.D., Jae Hyung Park, M.D. *Interventional Radiology*. 1st ed. Seoul: Ilchokak 1999:8-19
 19. Kim TK. *Embolization of abdominal visceral organs*. In Man Chung Han, M.D., Jae Hyung Park, M.D. *Interventional Radiology*. 1st ed. Seoul: Ilchokak 1999:49

J Korean Radiol Soc 2000;43:703 - 710

Transcatheter Arterial Embolization of Splanchnic Arterial Pseudonaneurysm: Focus on the Method of Embolization¹

Ji-Kang Park, M.D., Jae Cheol Hwang, M.D.², Deok Hee Lee, M.D.³, Hyun-Ki Yoon, M.D.³,
Ho-Young Song, M.D., Kyu-Bo Sung, M.D.

¹Department of Radiology, Asan Medical Center, University of Ulsan College of Medicine

²Department of Radiology, Ulsan University Hospital

³Department of Radiology, Asan Foundation, Kangnung Hospital

Purpose: To evaluate the effectiveness of transarterial embolization of splanchnic arterial pseudoaneurysm and to analyze the embolization technique.

Materials and Methods: Between 1991 and 1999, 38 patients with splanchnic arterial pseudoaneurysm underwent transarterial coil embolization. The parent artery was embolized just distal and proximal to the neck of the pseudoaneurysm in 26 cases, and proximal to the aneurysmal neck in nine. In four patients, embolization involved the use of gelfoam, and in the other two patients, coil packing of the pseudoaneurysm sac was performed.

Results: Initial bleeding was controlled in 34 of the 38 patients (89%) treated by transarterial embolization (in 24 of 26 who underwent distal and proximal embolization, in seven of nine whose treatment involved proximal embolization and in two of four in whom gelfoam embolization was undertaken). In seven patients (18%), re-bleeding occurred within 0 - 14 (mean, 6.4) days of initial embolization. In two cases, bleeding reoccurred from the same artery initially treated by gelfoam embolization, in two others from that in which coil packing of the pseudoaneurysmal sac had been performed, and in three, from a different artery. Among these seven patients, one died from bleeding and the remaining six were successfully treated by repeated embolization. In spite of successful bleeding control, nine patients (24%) died of subsequent bleeding-related complications, namely sepsis (n = 4), acute respiratory failure (n = 3), and multi-organ failure (n = 2).

Conclusion: For the treatment of splanchnic arterial pseudoaneurysm, transarterial embolization was a relatively simple and effective procedure. Proximal and distal coil embolization at the pseudoaneurysmal neck successfully isolated the of pseudoaneurysm and prevented the recanalization of blood flow.

Index words : Arteries, injuries
Arteries, interventional procedure
Arteries, therapeutic embolization

Address reprint requests to : Ji-Kang Park, M.D., Department of Diagnostic Radiology, Asan Medical Center,
University of Ulsan College of Medicine, 388-1, Pungnap-dong, Songpa-gu, Seoul 138-736, Korea.
Tel. 82-2-2224-4368 Fax. 82-2-476-4719