

:

: 5 187 8 (1-59 , : 39 )  
1-40 ( 18 ) 가(AST/ALT)  
가 . 6

1  
2 . 4  
, 가  
:  
:  
가 1 가가 3 가  
6-17 1 3  
4  
1 1

:

, ,  
가 . ,

, 1994 1999 187  
(1-3). 가  
8  
5 ,  
2 , 1 39 (1 -  
59 ) 4 , 4 . 2 , 6  
( : 2, : 4)  
(4-7)  
(8-11).  
1-40 ( : 17 )  
가 가  
(AST/ALT) 가 6  
(75%) 1000 가가  
6-Fr sheath  
5-Fr R-H catheter  
50% 6

6 - Fr guiding catheter(Enboy, Cordis corporation, Miami, U.S.A.)

Micro - ferret catheter(0.018 inch, Cook, Bloomington, U.S.A.)

Dasher microguidewire

Floppy II guidewire(0.014 inch, Cordis corporation, Miami, U.S.A.)

(nitroglycerin) 100  $\mu$ g 5000 - 10000 unit

5 2.0 - 3.5 mm, 1.3 - 2 cm

VIVA - primo balloon catheter(Boston Scientific International, Paris, France)

Adante balloon catheter(Boston Scientific International, Paris, France)

1 6 mm, 4 cm

3 - 4

가  
20%

1

10

(urokinase)

(Fig. 1).

2

10

20

4000

가

(Fig. 2).

4

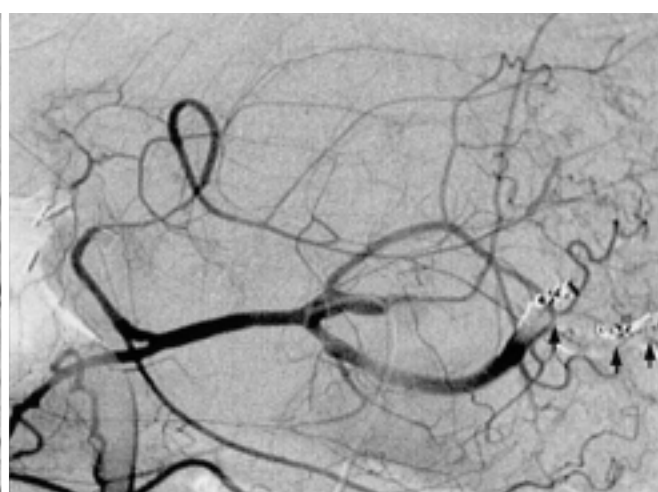
가

(n = 1),

(n = 2),



A



B



C



D

**Fig. 1.** Hepatic angiograms of a 59-year-old man with markedly elevated liver enzyme level (AST/ALT = 694/1249).

**A.** Hepatic arteriogram shows complete occlusion at the anastomosis.

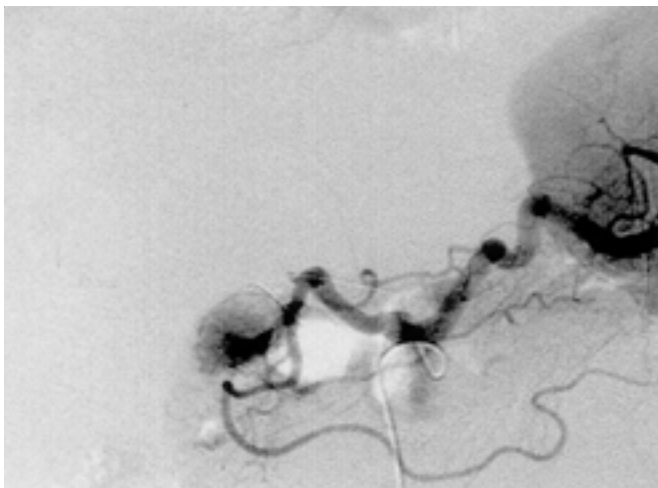
**B.** Hepatic arterial flow increased after thrombolysis (urokinase 100,000 U) and coil embolization of splenic artery (arrows), but luminal narrowing remained.

**C.** Angioplasty was performed with a 2.5-mm balloon.

**D.** After angioplasty, hepatic perfusion more improved without residual stenosis.

Angioplasty was repeated again 1 week later due to restenosis (not shown) No further treatment required during six months follow-up.

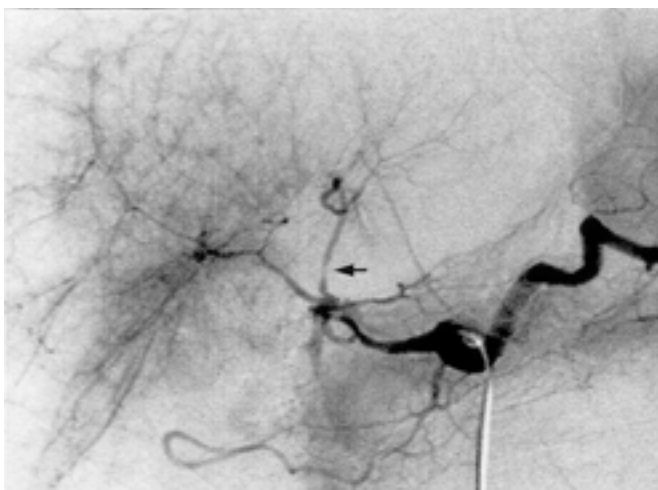
(n = 1)  
가 . 가  
가  
18  
(1 - 40 )  
1 - 2 cm  
6  
20%  
2  
가  
3  
4  
3  
가 가 1  
1 - 2  
6 - 17  
2 가  
가 1  
2.5 cm, 3.5 mm NIR primo stent (Boston Scientific International, Paris, France)  
가  
(Fig. 3).  
2 1  
1 가



A



B



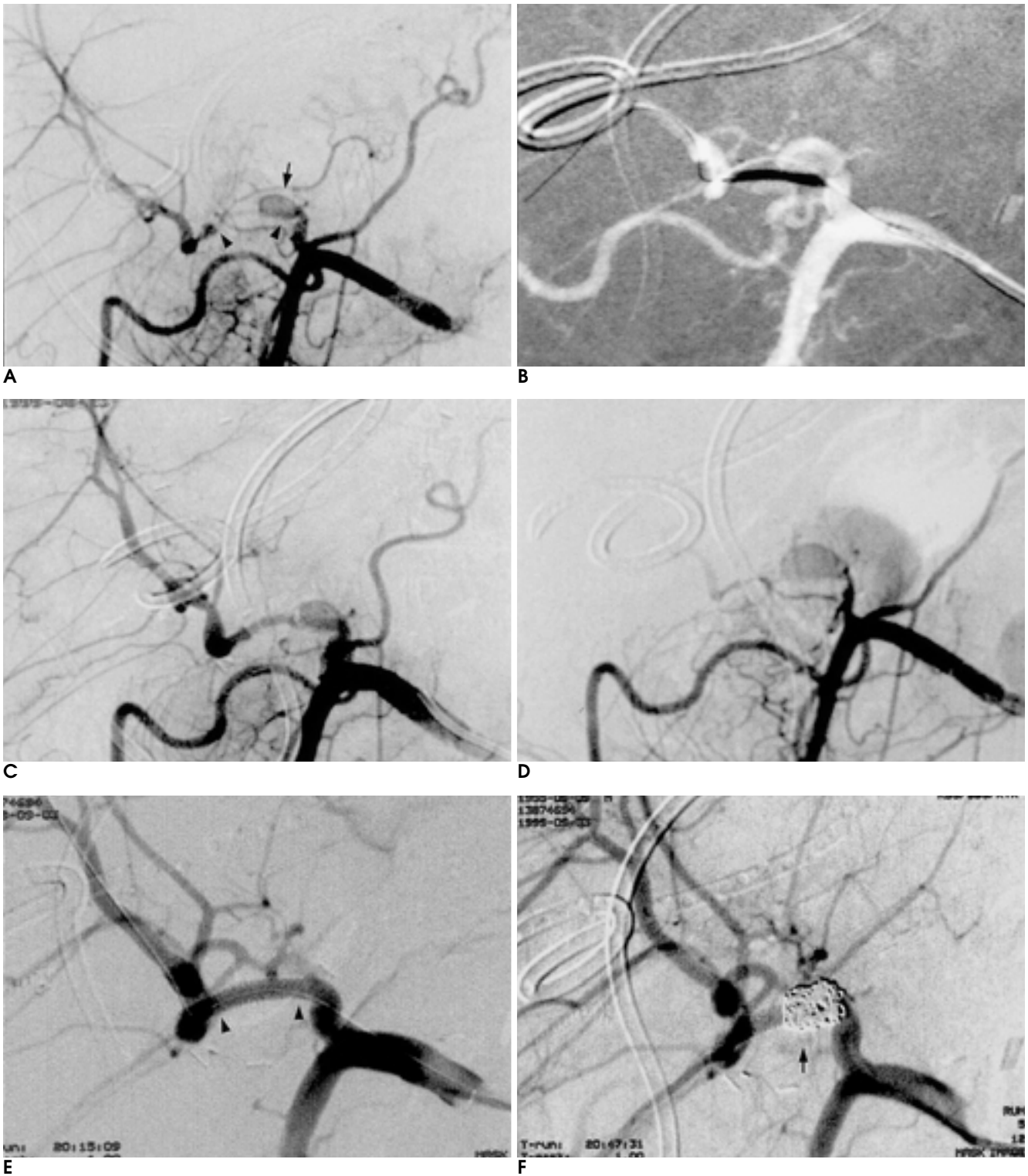
C

**Fig. 2.** Hepatic angiograms of a 58-year-old man with markedly elevated liver enzyme level (AST/ALT = 3657/5236).

**A.** Celiac angiogram shows complete occlusion at the anastomosis of the common hepatic artery and the short segment of proper hepatic artery.

**B.** After thrombolysis (urokinase 200,000 U), right hepatic artery was visible, but left hepatic artery was not visible.

**C.** After repeated thrombolysis, angiogram shows improved hepatic flow and visible left hepatic artery. Luminal narrowing (arrow) of left hepatic artery was thought to be due to spasticity rather than dissection. This patient died of graft failure and coagulopathy 4 days later.



**Fig. 3.** Hepatic angiograms of a 43-year-old man with mildly elevated liver enzyme level (AST/ALT = 86/205).

**A.** Arteriogram shows severe stenosis (arrowheads) of proper hepatic artery and pseudoaneurysm (arrow). Liver function was normal because of preserved hepatic perfusion.

**B.** Angioplasty was performed with a 2.5-mm balloon.

**C.** After balloon angioplasty, luminal diameter increased and hepatic flow improved.

**D.** Angiogram after 11 days shows severe restenosis and enlarged pseudoaneurysm that could have caused compression or spasticity of hepatic artery.

**E.** After repeated angioplasty with a 3.5-mm balloon and 3.5-mm stent placement (arrowheads) for restenosis, angiogram shows normal luminal diameter and good hepatic flow.

**F.** Hepatic arterial diameter was preserved after microcoil embolization of the pseudoaneurysm (arrow).

**Table 1.** Summary of Patient Data of Hepatic Artery PTA and Thrombolysis in Liver Transplant Recipients

Pt. No.	Age(yrs)	Underlying Disease	Transplanted Segment	Time Interval after Transplantation(days)	Liver Enzyme Level (AST/ALT)
1	54	Liver cirrhosis	Whole liver	1	8755/2637
2	33	Fuminant hepatitis	Right lobe	7	6003/2634
3	58	Liver cirrhosis	Left lobe	17	1099/931
4	3	Biliary atresia	Left lateral Segment	23	140/32
5	43	Liver cirrhosis	Right lobe	40	86/205
6	59	Liver cirrhosis	Left lobe	17	694/1249
7	58	Liver cirrhosis	Whole liver	7	3657/5236
8	1	Biliary atresia	Left lobe	22	2036/936

**Table 2.** Summary of Results of Hepatic Artery PTA and Thrombolysis in Liver Transplant Recipients

Pt. No.	Balloon Size(mm), Urokinase	Initial Result	Sites of Coil Embolization	Follow-up & Clinical Outcomes
1	6 mm × 4 cm	Success	Gastroduodenal Artery	Died of primary nonfunction of graft liver at 1day (postop. 2days)
2	2 mm × 1.3 cm	Success	Splenic Artery	Died of hepatorenal syndrome & acute rejection at 3days(postop 10days)
3	2.5 mm × 1.3 cm	Success		Repeat PTA at 1wk, 2wks. Asymptomatic at 17months
4	3.0 mm × 1.3 cm	Success		Died of acute rejection, graft failure & coagulopathy, ICH at 1day(postop. 24days)
5	2.5 mm × 1.3 cm 3.5 mm × 2 cm 3.5 mm × 2.5 cm (S <sup>†</sup> )	Success	Repeat PTA at 1wk, 2wks	Embolization of pseudoaneurysm Asymptomatic at 6 months
6	UK 100,000 unit 2.5 mm × 1.3 cm	Success	Splenic Artery Rt. Gastric Artery	Repeat PTA at 1wk Asymptomatic at 6 months
7	UK 200,000 unit. No PTA	Insufficient		Repeat Thrombolysis at 2days Died of graft failure & coagulopathy at 4 days(postop. 13days)
8	UK 100,000 unit No PTA	Insufficient	Splenic Artery	Retransplantation due to liver necrosis at 2days(postop 24days)

ICH : Intracranial Hemorrhage, UK: Urokinase, PTA: Percutaneous Transluminal Angioplasty, S<sup>†</sup>: Stent

가 , 가 .  
1 - 2 cm  
7 (92%) 1  
(biloma) (1 - 5). 20%  
6 - 13%  
3 (3), 1  
4%  
가 (4 - 7)  
Orons (8)  
가  
(1, 2).  
Orons (2) 1 가 가  
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- 가  
가 (1 - 3). 가 가  
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가 1000 가  
가 가  
가가 가  
가 가  
가 가  
가  
가 2  
42% 4% (1 - 3).  
가  
3 (2%)  
가  
2  
가  
2  
1  
가  
(5 - 7).  
가  
Vorwerk (12)  
가  
2%
1. Bowen A, Hungate RG, Kaye RD, Reyes J, Towbin RB. Imaging in liver transplantation. *Radiol Clin North Am* 1996; 34:757-778
  2. Orons PD, Zajko AB. Angiography and interventional procedures in liver transplantation. *Radiol Clin North Am* 1995; 33:541-558
  3. Wozney P, Zajko AB, Bron KM, Point S, Starzl TE. Vascular complications after liver transplantation: a five year experience. *AJR Am J Roentgenol* 1986; 147:657-663
  4. Abbasoglu O, Levy MF, Vodapally MS et al. Hepatic artery stenosis after liver transplantation-incidence, presentation, treatment, and long term outcome. *Transplantation* 1997; 63(2):250-255
  5. Langnas AN, Marujo W, Stratta RJ, et al: Hepatic allograft rescue following arterial thrombosis. *Transplantation* 1991; 51: 86-90
  6. Lallier M, St. Vil D, Dubois J, et al. Vascular complications after pediatric liver transplantation. *J Pediatr Surg* 1995; 30:1122-1126
  7. Yanaga K, Lebeau G, Marsh JW, et al. Hepatic artery reconstruction for hepatic artery thrombosis after orthotopic liver transplantation. *Arch Surg* 1990; 125:628-831
  8. Orons PD, Zajko AB, Bron KM, Trecha GT, Selby RR, Fung JJ. Hepatic artery angioplasty after liver transplantation: experience in 21 allografts. *J Vasc Intervent Radiol* 1995; 6:523-529
  9. Langnas AN, Majuro W, Stratta RJ, et al. Vascular complications after orthotopic liver transplantation. *Am J Surg* 1991;161:71-83
  10. Raby N, Karani J, Thomas S, O Grady J, Williams R. Stenoses of vascular anastomoses after hepatic transplantation: Treatment with balloon angioplasty. *AJR Am J Roentgenol* 1991;157:167-171
  11. Abad J, Hidalgo EG, Cantarero JM, et al. Hepatic artery anastomotic stenosis after transplantation: Treatment with percutaneous transluminal angioplasty. *Radiology* 1989;171:661-662
  12. Vorwerk D, Gunther RW, Klever P, Riesener KP, Schumpelick V. Angioplasty and stent placement for hepatic artery thrombosis following liver transplantation. *J Vasc Intervent Radiol* 1994; 5: 309-311

## Radiologic Management of Hepatic Arterial Stenosis or Thrombosis Following Liver Transplantation<sup>1</sup>

Byung Suck Shin, M.D., Kyu-Bo Sung, M.D., Soo Mee Lim, M.D.,  
Hyun-Ki Yoon, M.D., Ho-Young Song, M.D.

*<sup>1</sup>Department of Diagnostic Radiology, Asan Medical Center, University of Ulsan, College of Medicine*

**Purpose:** To assess the results and usefulness of interventional procedures for hepatic arterial stenosis or thrombosis following liver transplantation.

**Materials and Methods:** During the past five years, eight patients aged 1 - 59 (mean, 39) years among 187 liver transplant recipients showed elevated of liver enzyme levels (AST/ALT) and decreased arterial flow at Doppler ultrasound. Hepatic arteriography revealed luminal stenosis or occlusion at the proper hepatic artery, and six patients, one of whom required thrombolysis before the procedure, underwent percutaneous transluminal angioplasty (PTA) using a balloon. In two with thrombosis, thrombolysis without PTA was performed. In order to increase hepatic arterial flow, four patients underwent additional coil embolization of the gastroduodenal or splenic artery.

**Results:** Hepatic arterial flow recovered in all six patients after PTA. Three required repeat PTA for restenosis and one of these needed stent placement after repeated PTA. At follow-up, 6 - 17 months later, the three had good hepatic function. Within four days, the other three expired due to graft failure, hepatorenal syndrome and sepsis. One of the patients who underwent thrombolysis without PTA expired and the other required re-transplantation. In this case there were no procedure - related complications.

**Conclusion:** Radiologic interventions are useful for treatment of hepatic arterial stenosis or thrombosis in patients with liver transplantations.

**Index words :** Liver, transplantation  
Surgery, complications  
Hepatic arteries transluminal angioplasty  
Thrombolysis

Address reprint requests to : Kyu-Bo Sung, M.D., Department of Diagnostic Radiology Asan Medical Center  
388-1 Poongnap-Dong, Songpa-Ku, Seoul 138-736, Korea.  
Tel. 82-2-2224-4368 Fax. 82-2-476-4719 E-mail: kbsung@www.amc.seoul.kr