Case Study: HCC with Extrahepatic Collateral Supply

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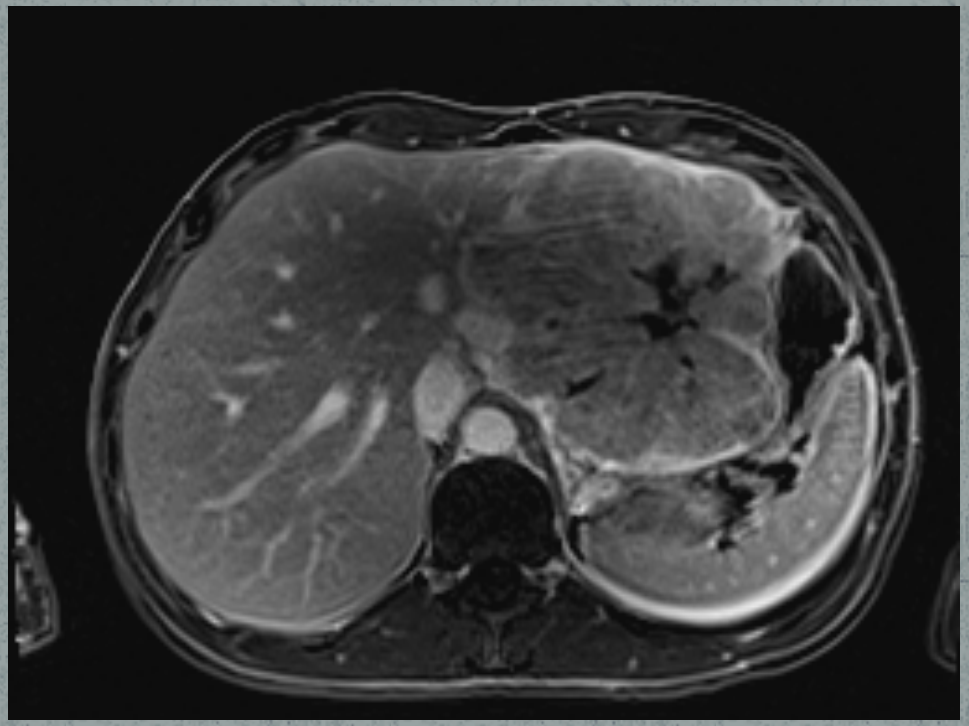
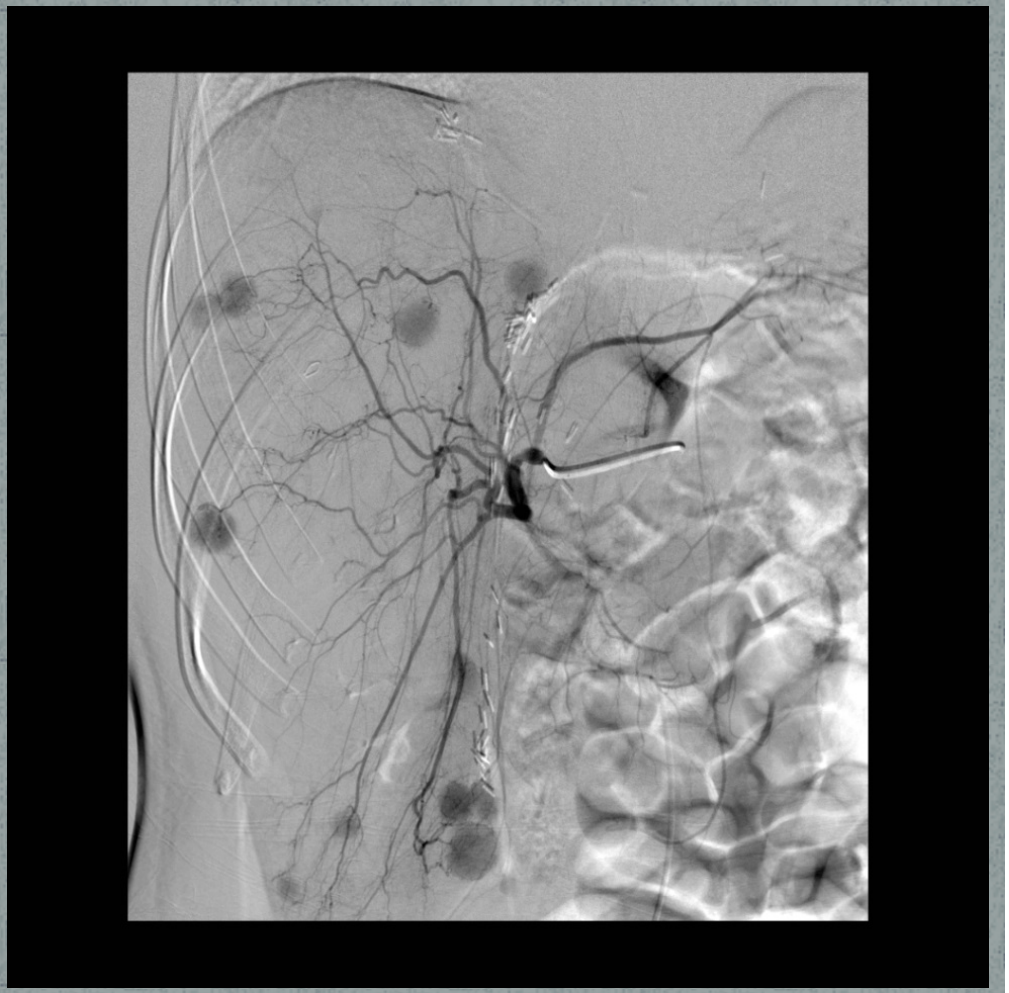
35 y/o male

- Stage IV HCC
  - Fibrolamellar variant
- Initial MRI
  - 11/02/09
- Left hepatectomy & partial right hepatectomy positive LN (6 of 51)
  - 11/16/09



Prior Interventions

- TACE
  - Rt HA in Nov ’10
- XRT to pelvic node
  - 4 weeks Jun ’11
- DEB-TACE
  - Rt HA in Aug ‘11, Jan ‘12, July ‘13



Preprocedure Labs

- WBC 5.0
- HCT 37.4
- HGB 12.4
- PLT 229
- PT/INR 13.4/1.1
- Creatinine 0.76
- eGFR >60
- Total Bilirubin 0.3
- Transaminase-SGPT 28
- Transaminase-SGOT 53

Preprocedure CT (8/13/13)

- Note hypervascular liver tumors in the periphery
- Note hypertrophic artery feeding peripheral tumors (originating off of right renal artery)

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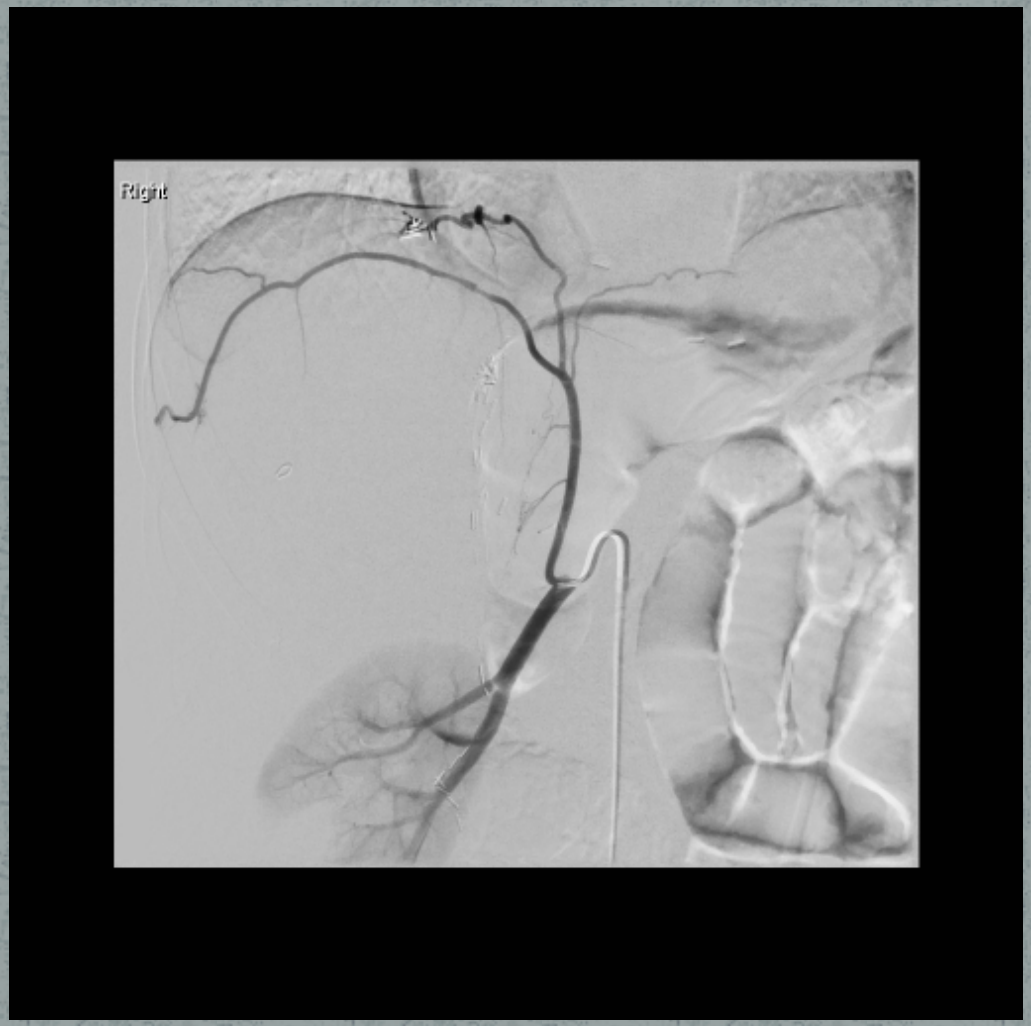
Intra-arterial Procedure (8/20/13)

Celiac artery run:

- No tumor blush noted



Right renal artery run:

- Right inferior phrenic artery arises from right upper pole renal artery
- Contrast noted within multiple vascular tumors

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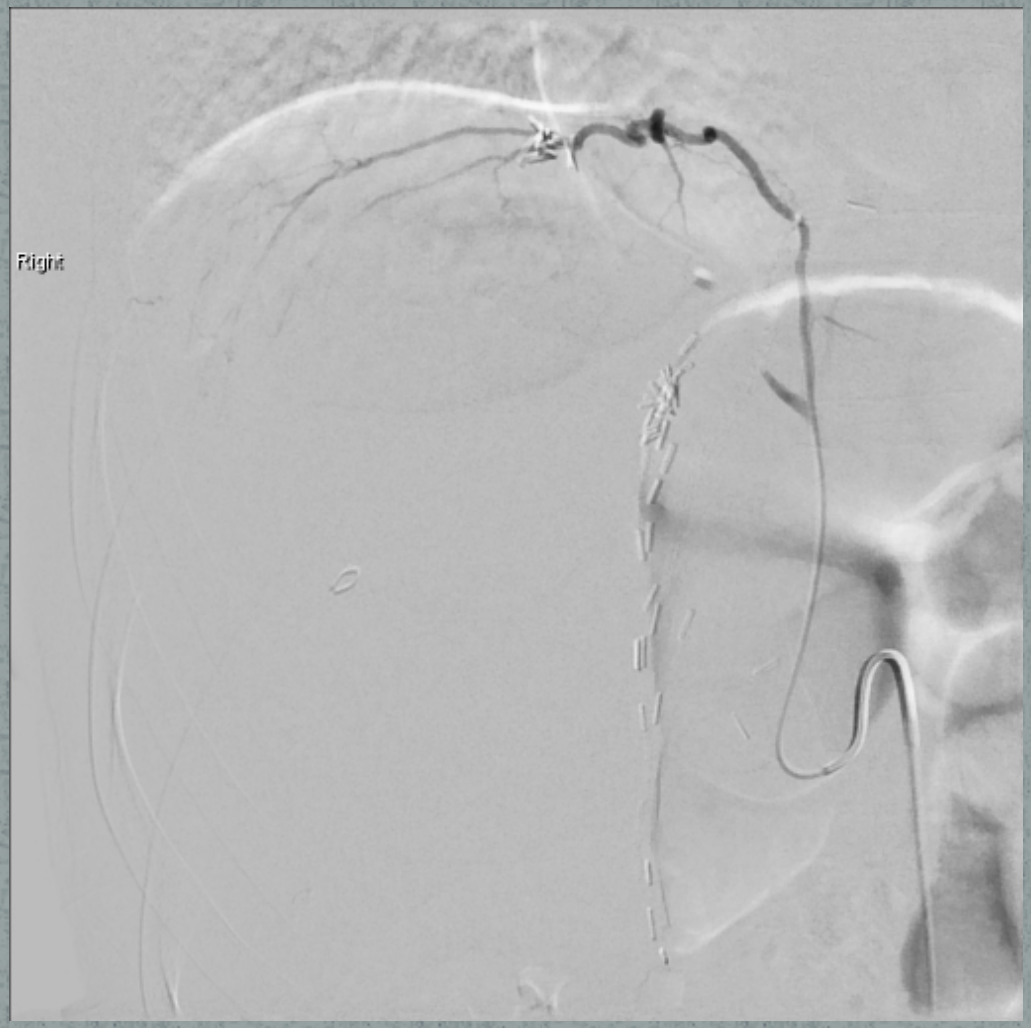
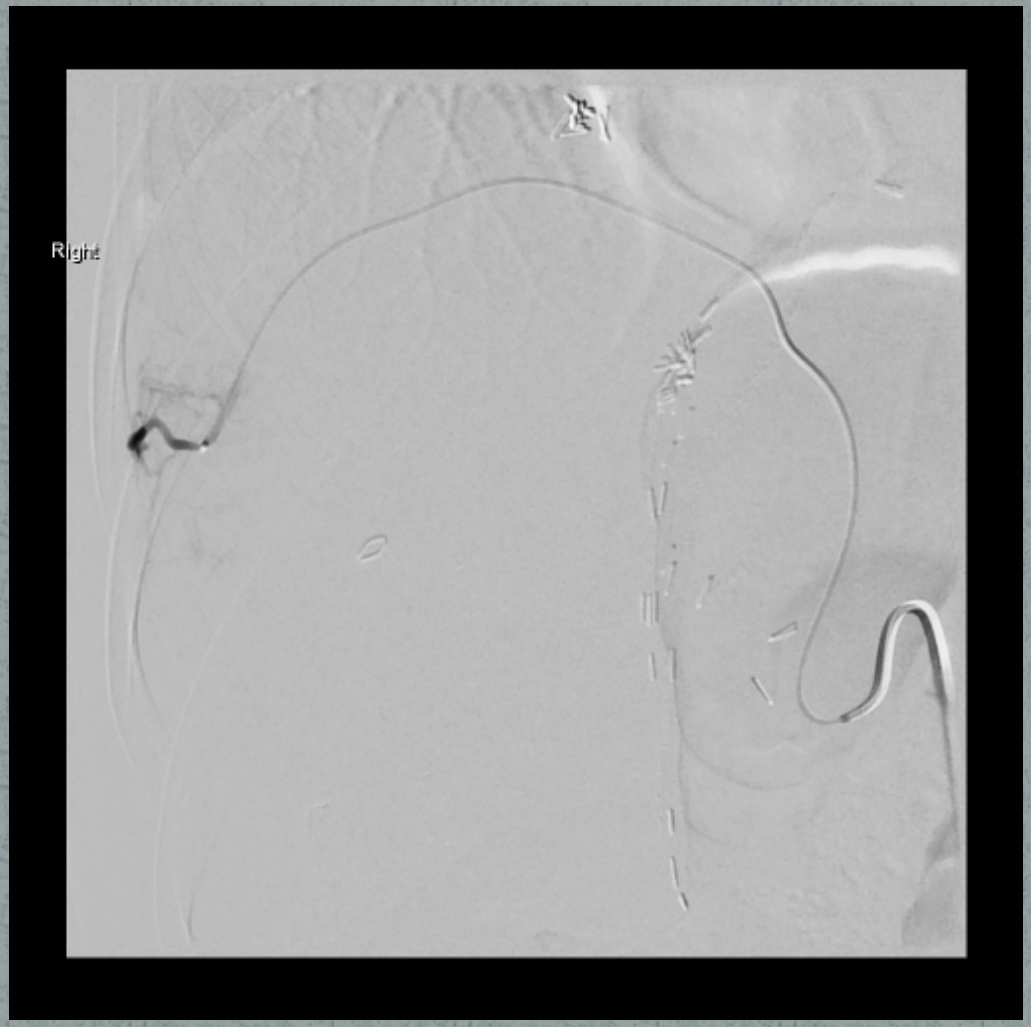
Selective right inferior phrenic artery run:

- Superior (anterior) and Inferior (posterior) branches supply multiple hypervascular HCCs



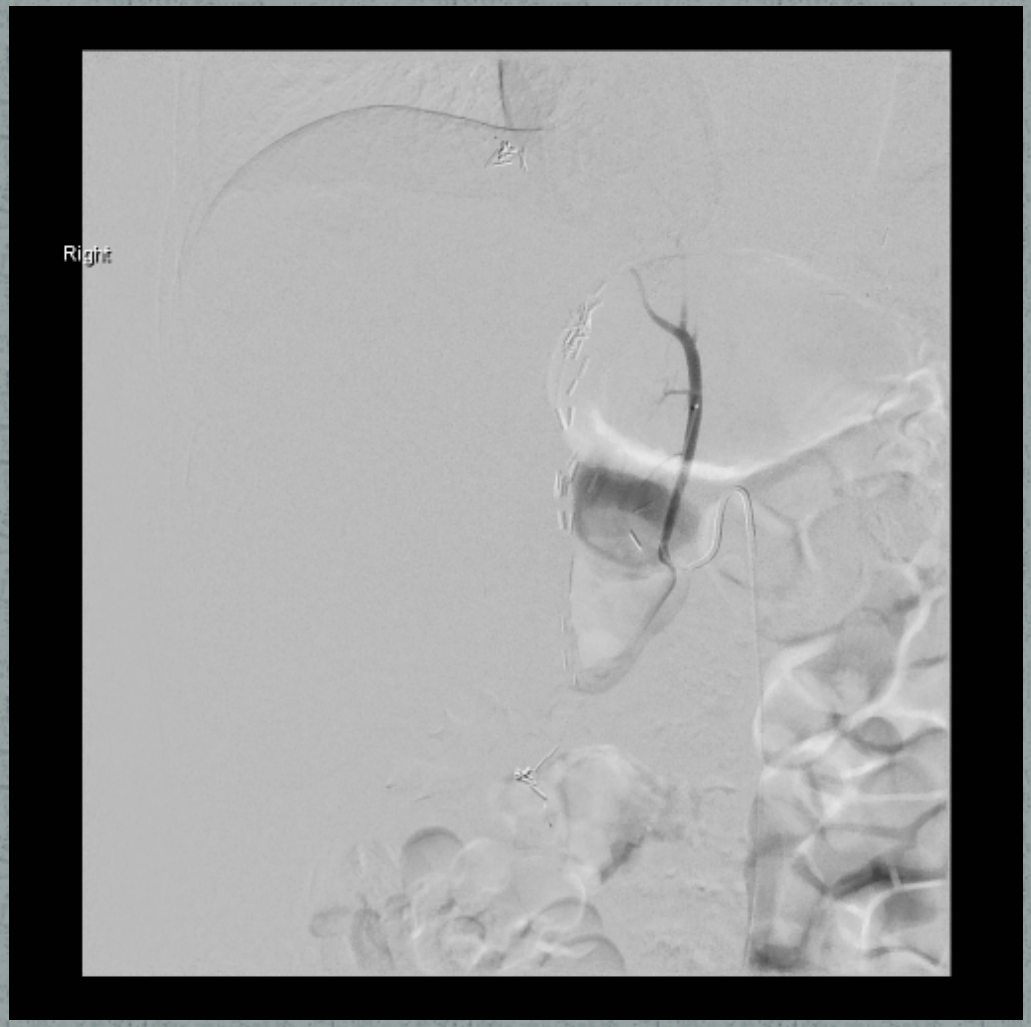
Subselective right inferior phrenic artery run:

- Superior (anterior) branch supplies multiple hypervascular HCCs
- Bland embolization (500-700 micron spheres)



Subselective right inferior phrenic artery run:

- Inferior branch supplies single large hypervascular HCC lateral right lobe
- Bland embolization (250 Embozene followed by 500-700 micron spheres)



Right renal artery run:

- Post-embolization run from upper pole right renal artery branch
- No tumor blush identified

Right renal artery run:

- No aberrant vessels arising off lower pole right renal artery

Goals of Therapy

- Make patient disease free
- Downstage to resection
- Prolong survival
- Control symptoms

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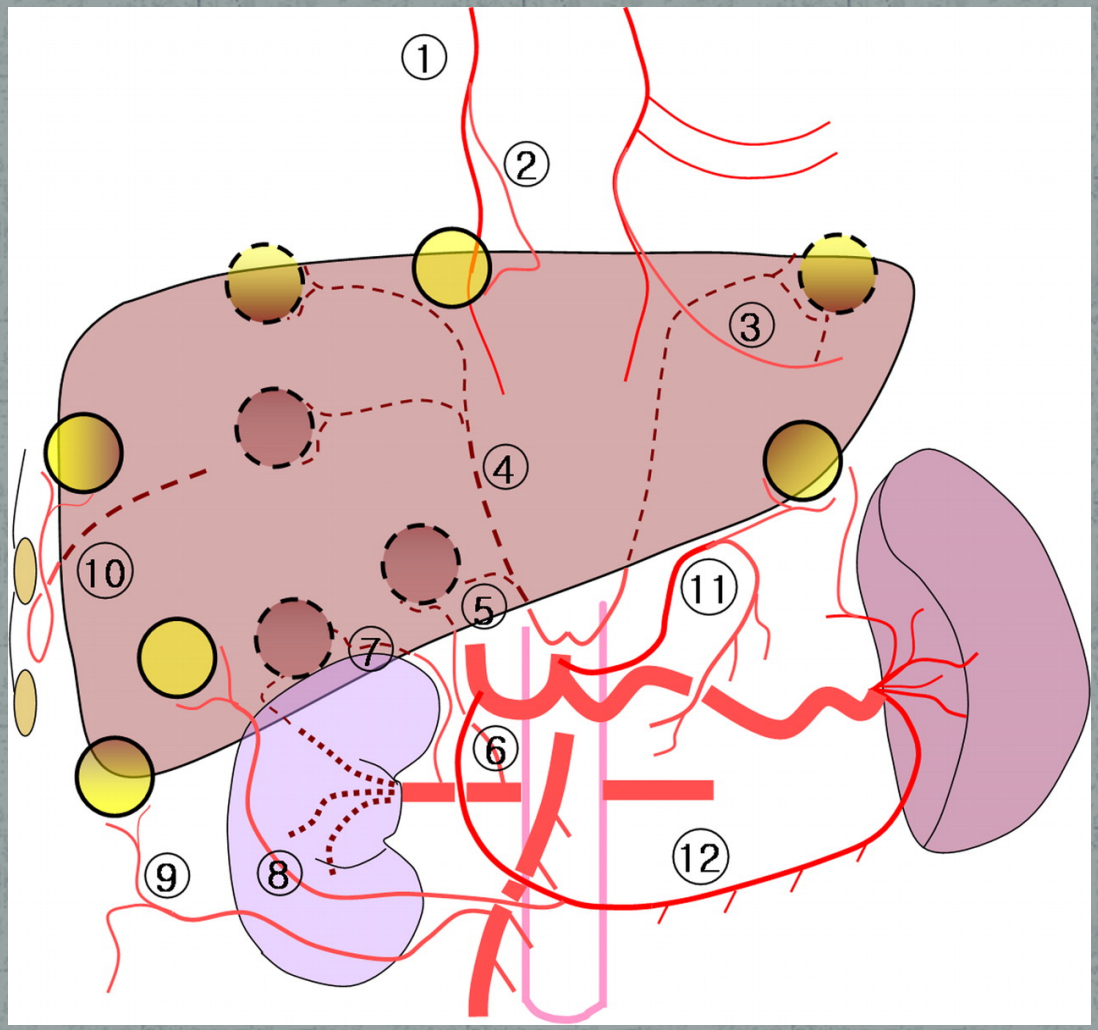
- Downstage to resection
- **Prolong survival**
- **Control symptoms**

Potential extrahepatic collateral arteries that supply HCCs according to anatomic location. 1 = internal mammary artery, 2 = pericardiophrenic artery, 3 = musculophrenic artery, 4 = inferior phrenic artery, 5 = superior adrenal artery, 6 = inferior adrenal artery, 7 = superior renal capsular artery, 8 = omental branch, 9 = colic branch, 10 = intercostal artery, 11 = left gastric artery, 12 = gastroepiploic artery.



Kim H, et al. Radiographics 2005;25:S25-S39

Extrahepatic Collateral Vessels Supplying HCC in 3179 Patients

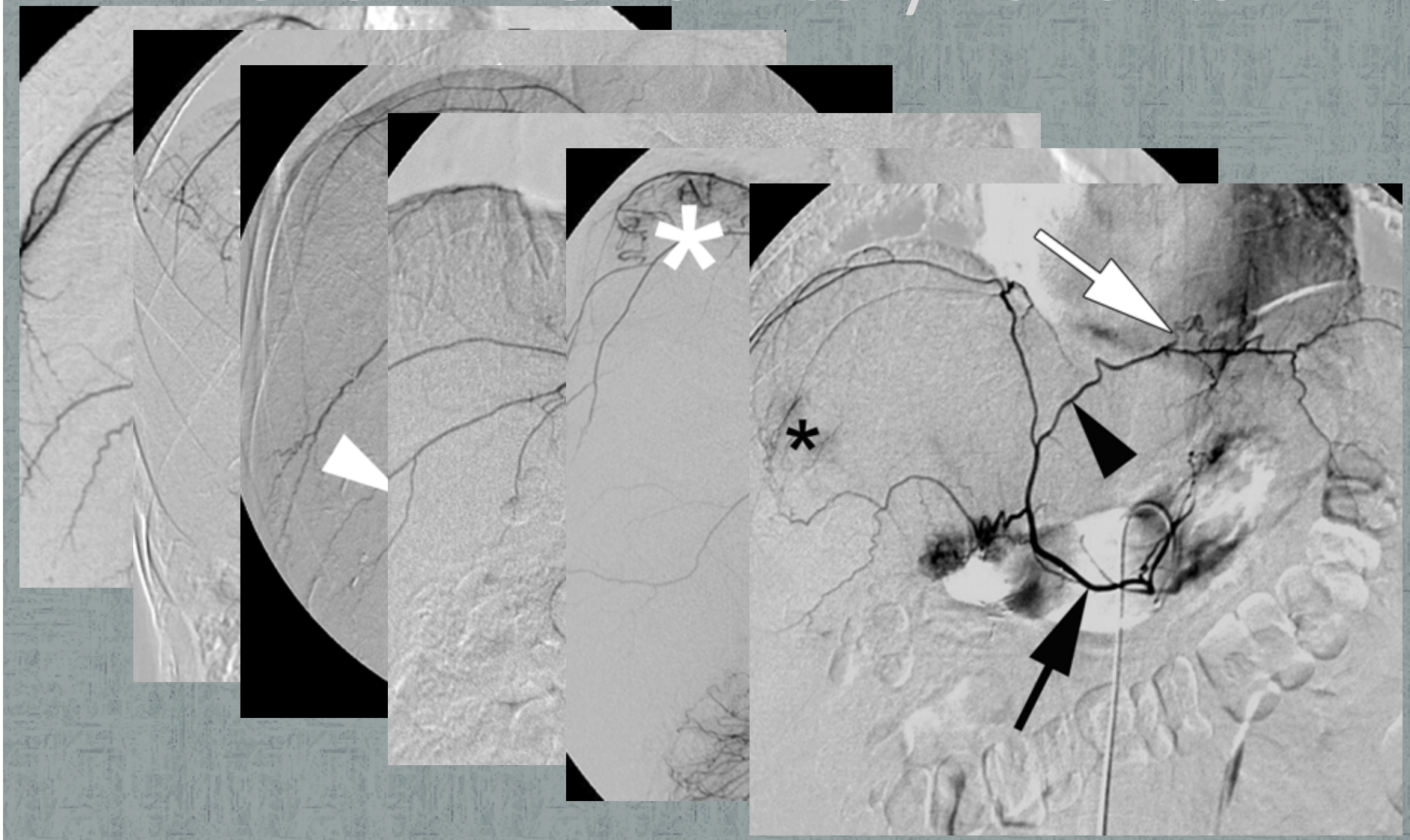
Collateral Vessel	Observed Vessels	Embolized Vessels*
Right inferior phrenic artery	1026	864 (84)
Omental branch	306	176 (58)
Adrenal artery	188	152 (81)
Intercostal and subcostal artery	128	83 (65)
Cystic artery	89	82 (92)
Left inferior phrenic artery	78	58 (74)
Right internal mammary artery	76	59 (78)
Renal or renal capsular artery	70	29 (41)
Branch of superior mesenteric artery	48	20 (42)
Left gastric artery	46	12 (26)
Right gastric artery	23	5 (22)
Left internal mammary artery	21	14 (67)
Lumbar artery	5	2 (40)
Total	2104	1556 (74)

Kim H, et al. Radiographics 2005;25:S25-S39

Kim H, et al. Radiographics 2005

- 860 patients (27%) / 3179 total
  - Performed TACE in 732 patients via 1556 extrahepatic collateral vessels (74%)
  - Multiple extrahepatic collateral vessels were embolized in 221 patients (30%)
    - two vessels in 186
    - three vessels in 27
    - four vessels in 6
    - five vessels in 2
  - Remaining 511 had single vessel

Inferior Phrenic Artery Variants*



*Chung JW, et al. JVIR 1998;9:495–500
*Miyayama S, et al. CVIR 2006;29(1):39–48
*Kahn PC. Radiology 1967;88:1–8

IPA Anatomy & Variations in 383 Pts

Site of Origin	No. of Cases
Celiac axis	152 (39.7)
Aorta	148 (38.6)
Renal artery	59 (15.4)
Left gastric artery	14 (3.7)
Hepatic artery	8 (2.1)
Superior mesenteric artery	1 (0.3)
Contralateral IPA	1 (0.3)
Total	383 (100)

*Gwon D II, et al. Radiographics 2007;27:687–705

Causes of Extrahepatic Collateral Vessel Formation

- In the past
  - believed to be hepatic artery occlusion by surgical ligation*
  - Repeat TACE primary cause**
    - Arterial interruption
    - Arterial dissection

*MichelsNA. Cancer 1953;6:708–724
*CharnsangavejC, et al. Radiology 1982;144:485–494

**ShibataT, Kojima, et al. Radiat Med 1998;16:251–256
**NakaiM, et al. Radiology 2001;219:147–152

Causes of Extrahepatic Collateral Vessel Formation

- Current model
  - Most have widely patent hepatic artery*
    - only ~4% of patients - proximal hepatic artery occlusion
  - Anatomic location of tumor
    - adjacent to the bare area / suspensory ligaments
    - direct invasion / adhesions to organs
  - Previous surgery may predispose

- Attenuation or occlusion of hepatic artery may exaggerate the degree of collateral circulation

*Chung JW, et al. JVIR 1998;9:495–500
*Kim JH, et al. JVIR 1995;6:71–74

Findings at CT and Angiography

- Selective angio can be tedious & time consuming

- Initial CT scan
  - Direct invasion into adjacent organs
  - Exophytic growth pattern
  - Contact with ligaments & bare area of liver
  - Possible to observe hypertrophied extrahepatic collateral vessels

Considerations During Angiography

- Multiple collateral vessels can supply one tumor.
  - Local recurrence after chemoembolization
  - Arterial spasm/dissection
  - Proximal embolization
  - Variant arterial anatomy
- Correlate CT and angio findings

Potential Complications

- Risk of nontarget embolization → variety of complications depending on location
  - Lumbar/IMA: cutaneous problems
  - Gastric/omental/colic: GI ulcerations
  - Lumbar/intercostal (spinal branches): paraplegia
  - Cystic: cholecystitis
  - Phrenic: referred pain, atelectasis

Avoid Complications

- Meticulous technique
  - Selective catheterization
    - Microcath
  - Incremental embo
    - Reflux
  - Protect normal arteries
    - Coil
  - Spasm

Conclusions

- Extrahepatic collaterals commonly supply HCCs
  - if tumors are large or peripherally located
- Familiar with the imaging findings
  - these vessels may be detected at an early stage
- Knowledge of the vascular anatomy
- Performed superselectively to avoid possible complications.

Thanks.
Questions/Comments.

The End!