**IVC Replacement for Malignancy: How To Do It**

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I have no relevant financial relationships to disclose at this time

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**Our Approach***

- Infrarenal IVC resection without replacement if vein chronically occluded
- Replacement of para- and supra-renal IVC with low threshold to re-implant renal veins
- In situ reconstruction of retrohepatic IVC probably has broader applicability, versatility and similar efficacy as ex situ technique

*Select good risk patients; Work as a team

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**Externally-supported PTFE Graft**

- Readily available
- Resists visceral compression
- Maximum size is 20 mm diameter

Rings close to anastomoses, buttons for branch veins

Occasionally see small layer of pseudo intima or thrombus

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**Choice of Incision**

- Size of tumor
- Body habitus
- Costal flare
- Whether CPB necessary

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**Right Medial Visceral Rotation to Expose Suprarenal IVC**

- Anterior approach
  - Ligate and divide caudate lobe veins
- Retrohepatic
  - Divide ligaments to fully mobilize liver
55 y/o man with renal cell carcinoma and level IV tumor thrombus

Beware of dilated lumbers

Tumor resection, removal of tumor thrombus from R atrium, IVC and L renal vein

IVC resection and LRV reimplantation because of tumor invasion

Venous stent for stenosis at upper anastomosis

Retrohepatic IVC Replacement Using Total Vascular Isolation of Liver

- Secure place for supra-hepatic clamp
- Test clamp of the supra-hepatic IVC to determine level of hemodynamic support
- Transfer clamp to graft after washout of acid metabolites from liver
- Graft cut to length after max. inhalation/exhalation

70 y/o man with renal cell cancer, level III tumor thrombus and liver metastasis

Vascular tumor and thrombus

Note dilated lumbar vein

Liver metastasis with thrombus near R hepatic vein

Radical nephrectomy, R hepatectomy, removal of tumor thrombus and IVC reconstruction

Reconstruction of IVC from the L hepatic vein to the infrarenal cava

Graft to LRV

Cardiopulmonary Bypass

Intra-atrial IVC thrombus or Liver congestion
78 y/o woman with infiltrative retrohepatic IVC leiomyosarcoma

Involvement of R renal and hepatic veins

Operation under hypothermic circulatory arrest

- Recreation of hepatic vein orifices; hepatic and right renal vein reimplantation
- Graft from right atrium to left renal vein-caval confluence

56 y/o woman with retrohepatic IVC leiomyosarcoma and hepatic vein thrombus

- Significant liver congestion
- Tumor extends into right hepatic vein
- Bland thrombus in left renal vein and lower IVC

Operation under cardiopulmonary bypass, hypothermia and low flow

- Hepatic vein thrombectomy under direct vision
- Reimplantation of left / middle and right hepatic veins as 2 cuffs
- Graft from right atrium to renal vein-caval confluence

Mayo Clinic Experience with 110 Patients*

1990-2014

>3000 patients with retroperitoneal malignancy

110 patients
Circumferential resection / Graft replacement

>200 patients
Patch / primary closure / no reconstruction

Follow-up (months)
Mean: 54
Median: 39
Imaging: 88%

52% Female
Mean age 56 ± 15 yo
ECOG 0 or 1 = 90%

*Data for 102 pts presented at VAM 2014 by Mendes, et al.

Branch Vein Reconstructions in 65 Patients

Renal vein
Reimplantation 17
Interposition 8

Hepatic vein
Reimplantation 3
Incorporation 37
Adjuncts and Extent of Resection

- Total vasc. isolation liver: 19
- Venovenous bypass: 11
- Cardiopulmonary bypass: 8
- AV fistula: 3
- Intraoperative radiation: 19
- Concomitant resection: 80
- Kidney: 42
- Liver: 30
- Adrenal: 23
- Other: 26

Outcomes of 110 Patients With IVC Graft Replacement*

- Multiple segments: 67
- Isolated segment: 43
- Mortality: 2
- Any morbidity: 58
- Major adverse event: 15
- Graft Occlusion: 6
  - Early (1)
  - Late (5)
- Graft infection: 2

*Primary tumors: 36; secondary: 74

Life Table Analysis

- 1st patency: 92%
- Overall survival: 90%
- Cancer-free*: 51%
- 32%
- 24%

Contemporary Results

<table>
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<tr>
<th>Year</th>
<th>n</th>
<th>Type</th>
<th>Location*</th>
<th>Graft Mortality</th>
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<td>Bower**</td>
<td>2015</td>
<td>110</td>
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*IR= infrarenal  SR= suprarenal  SH= suprahepatic
**Multiple segments in remainder

Summary

- Primary and secondary malignancies of the inferior vena cava can be safely resected in select patients
- Keys to success are patient selection, a multidisciplinary team, and meticulous operative preparation and execution
- Externally-supported PTFE works well