

Extended Pulmonary Resections

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Introduction

- Lung cancers may infiltrate contiguous structures
- Most commonly: chest wall, vertebral body, diaphragm, left atrium, aorta, pericardium, esophagus and superior vena cava
- Ability to resect variable
- Prognosis related to the completeness of resection and presence of nodal metastases



Chest Wall Invasion

- Pain most reliable predictor of chest wall invasion
- Radiography unreliable in absence of clear soft tissue/bony invasion
- Exclude N2 disease if resection contemplated
- Goal: resection and reconstruction of chest wall
- Small defects covered by scapula or chest wall musculature do not require reconstruction
- Anterior or anterolateral defects: reconstruct



Chest Wall Invasion



Chest Wall Invasion

- Explore chest through incision away from area of suspected invasion
- Invasion is evident by firm fixation to chest wall
- If fixation not firm, inflammatory adhesion is the likely cause - remove with an extrapleural dissection
- Obtain frozen section on suspicious pleural surfaces



Chest Wall Invasion

- En-bloc resection for chest wall invasion
- Perform resection from outside-in, 3 cm margins recommended
- Lung resection performed through thoracotomy or chest wall defect
- Lateral defects: take 1 rib above and below with 3 cm margins anterior and posterior



Chest Wall Invasion

- Posterior and lateral defects behind scapula don't require reconstruction
- If 5th rib removed posteriorly, reconstruct to prevent entrapment of scapular tip: Marlex, Gore-Tex or Dacron
- For anterior or lateral defects a contoured rigid reconstruction is preferable – Marlex methylmethacrylate
- Taut 2mm Gore-Tex will cause deformity unless myocutaneous flap is overlaid



Chest Wall Invasion



Chest Wall Invasion

- Memorial Sloan Kettering: McCaughan et al. JTCVS. 1985; 89: 836.
- 125 chest wall resections - 5 year survival related to:
 - Completeness of resection (42% vs. 0%)
 - Lymph node metastases (56% vs. 20%)
 - Depth of chest wall invasion (50% vs. 16% for full thickness)
- Doddoli et al. Ann Thorac Surg. 2005; 80:2032.
- 309 chest wall resections
 - Lymph node metastases has significant impact on 5 year survival: IIB 40% and IIIA 12%

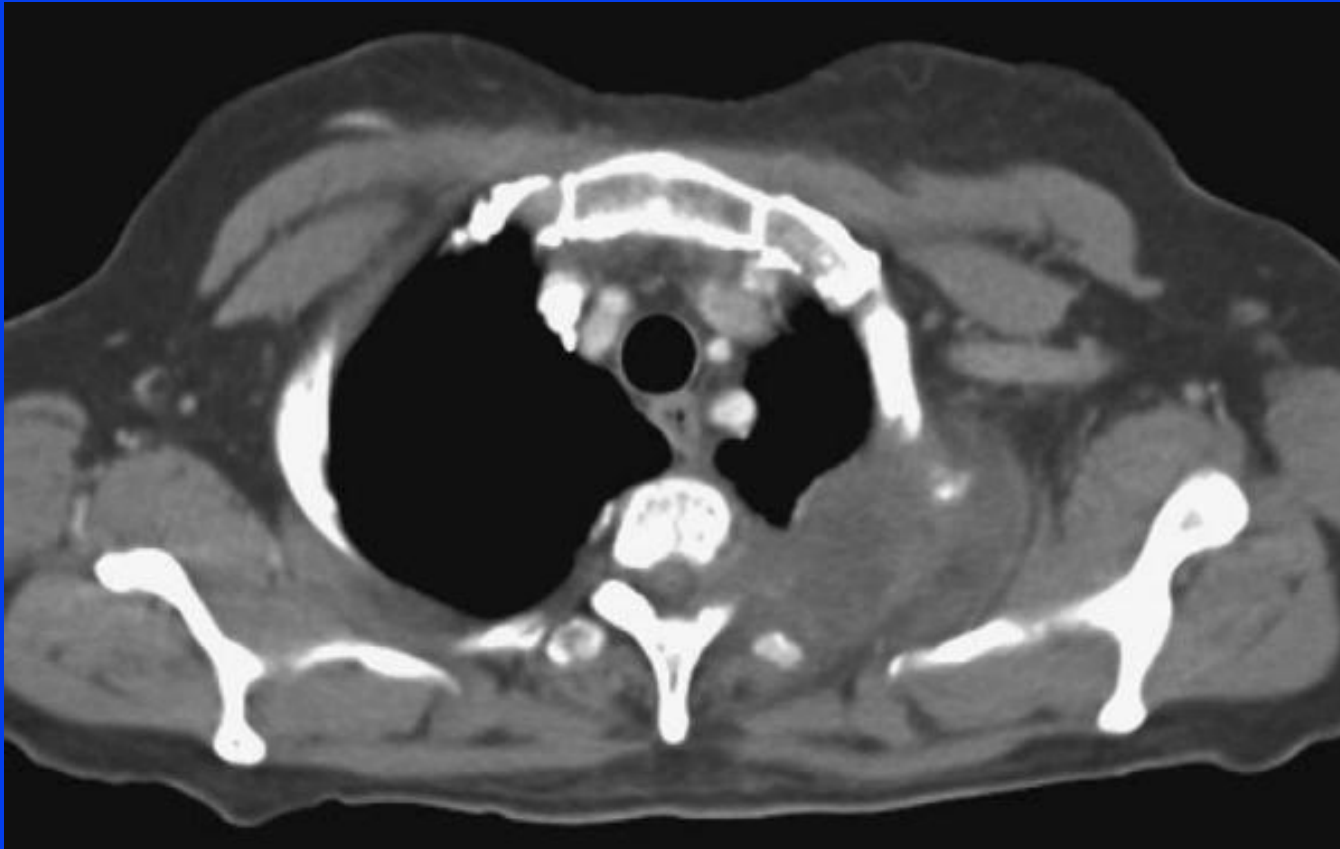


Vertebral Invasion

- Historically a contraindication to resection
- Technical advancements have decreased morbidity
- Limited survival suggests the problem of incomplete resection has not been resolved
- Typically occurs above the T5 level
- Seen well on CT and MRI
- Invasion of cortical bone is potentially resectable but invasion of cancellous bone is contentious



Vertebral Invasion

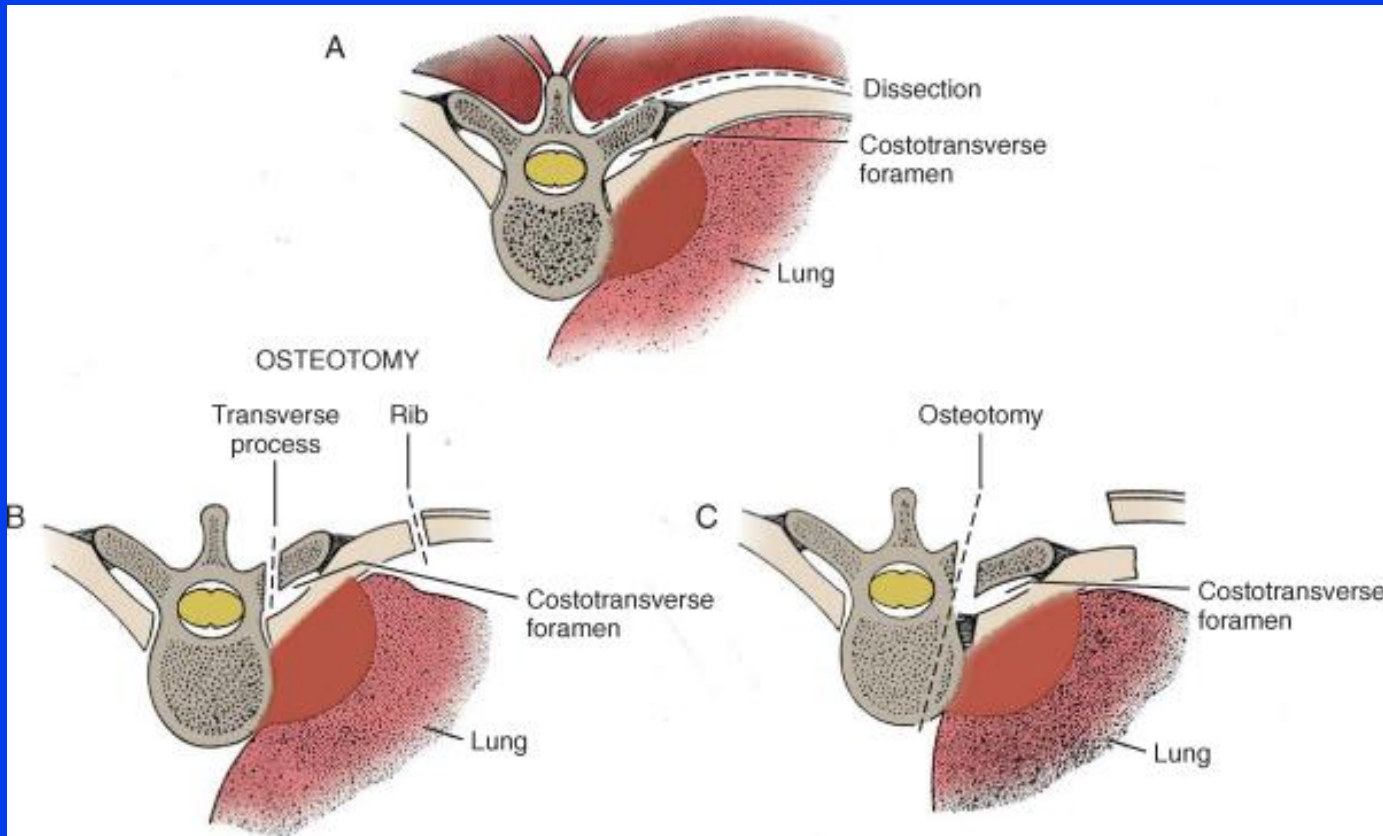


Vertebral Invasion

- Posterolateral thoracotomy extended to base of neck
- Pleural space entered one rib below involved vertebra
- Paraspinous muscles dissected off transverse process to midline



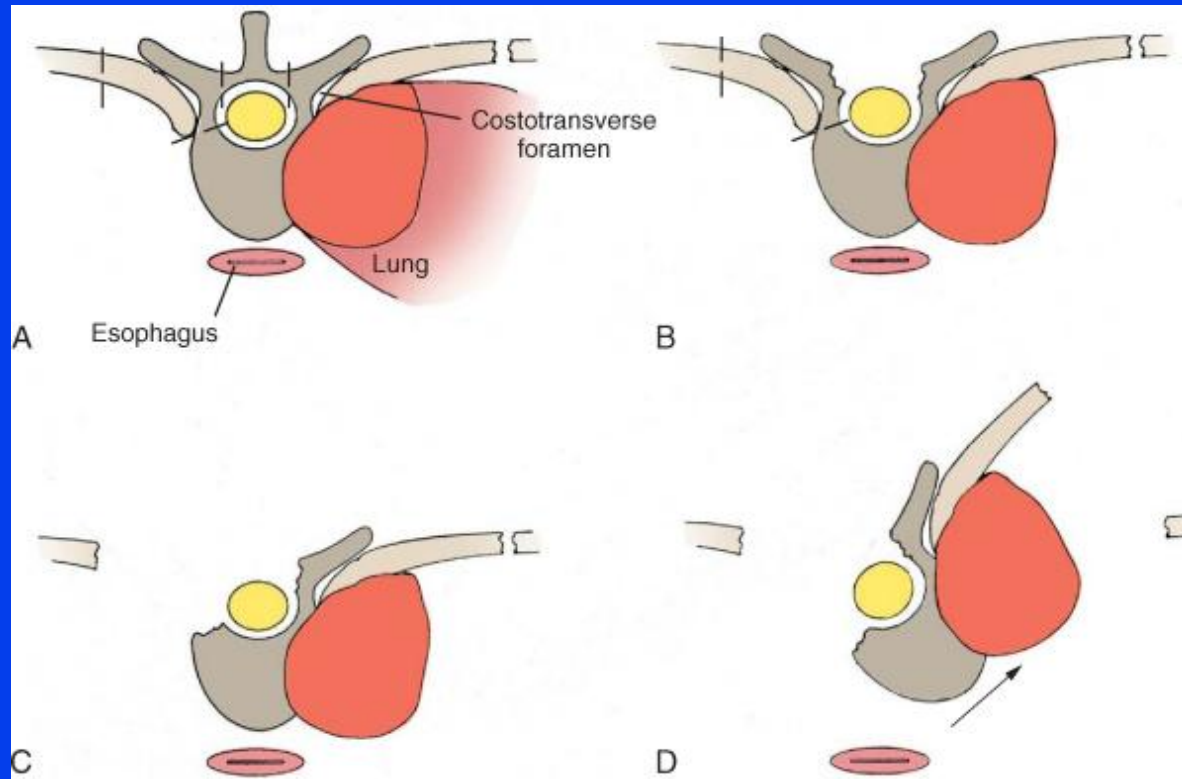
Vertebral Invasion: Partial Vertebral Resection



DeMeester et al. JTCVS. 97:373, 1989



Vertebral Invasion: Total Vertebrectomy



Pearson's Thoracic and Esophageal Surgery 3rd ed.

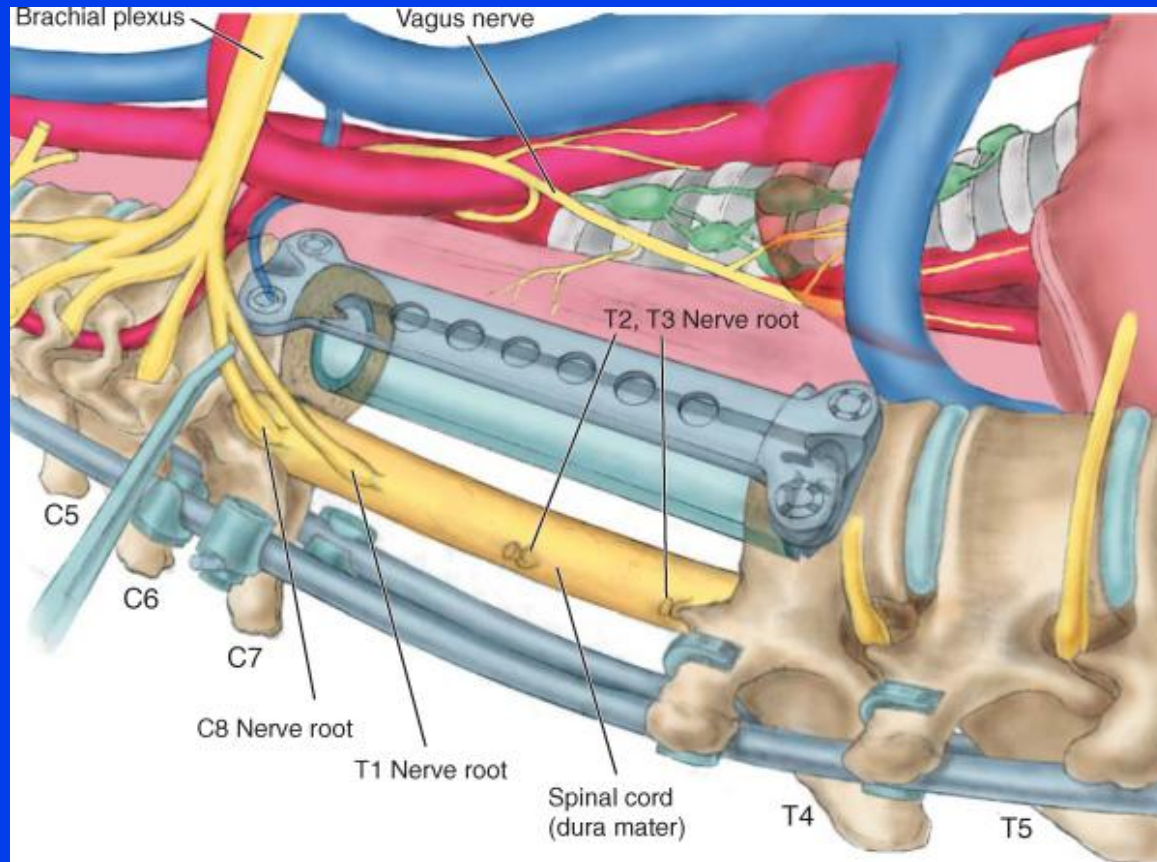


Vertebral Invasion

- Ghandi et al. Ann Thor Surg. 68:1778, 1999.
- 17 patients with superior sulcus tumors with vertebral invasion
- 30 Gy preop XRT and 54 Gy postop XRT
- 7 total vertebrectomies, 7 partial vertebrectomies and 3 resections of neuroforamen and transverse process
- 54% 2 year survival
- Completeness of resection important predictor of local recurrence



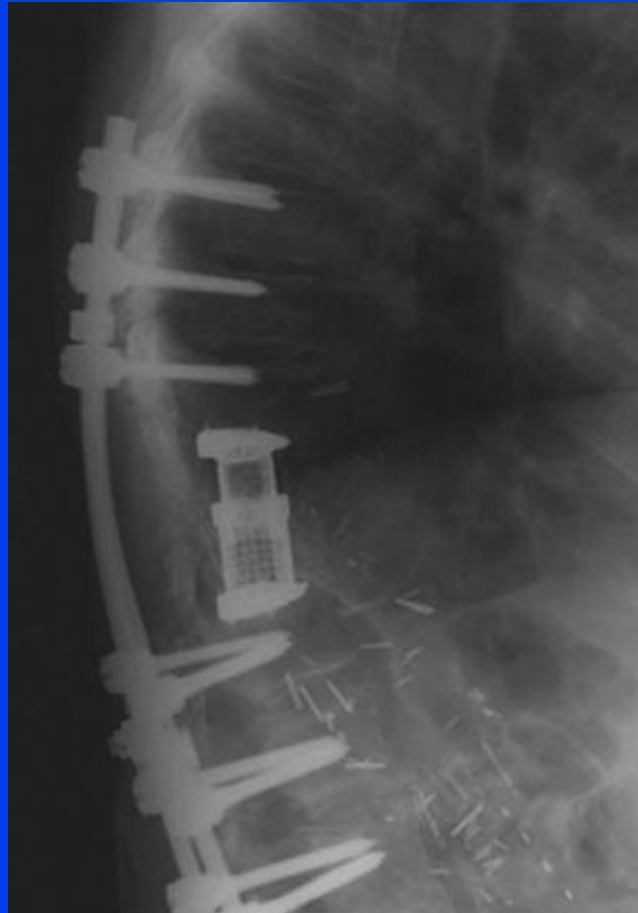
Vertebral Invasion: Reconstruction



Ghandi et al. Ann Thor Surg. 68:1778, 1999.



Vertebral Invasion: Reconstruction



Martin et al. Thor Surg Clin. 14:241, 2004.

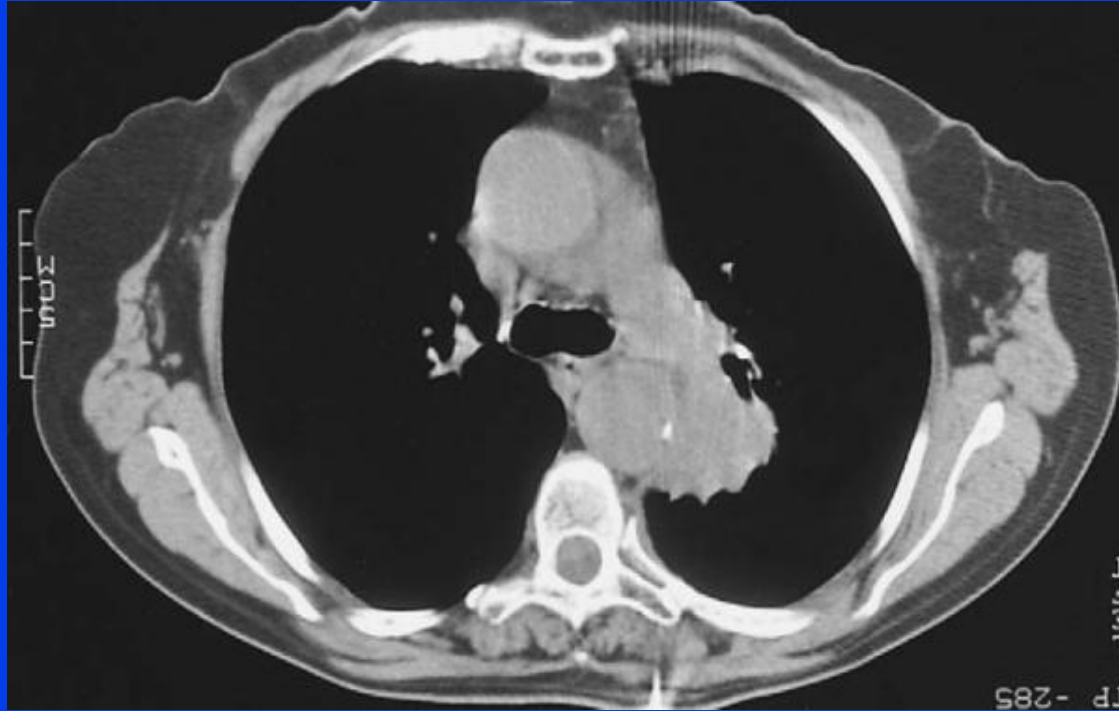


Aortic Invasion

- Not uncommon for left sided lung cancers
- Invasion suspected when:
 - tumor is apposed to aorta for $> 25\%$ of circumference
 - fat plane between two structures is lost
- Subadventitial aortic dissection may allow tumor clearance
- Full-thickness involvement generally a contraindication
- Resectability often cannot be determined without exploration



Aortic Invasion



Left lower lobe superior segment tumor with extensive apposition to the descending aorta and obliteration of fat plane. Lesion was resected with a subadventitial dissection.



Aortic Invasion

- Surgical techniques:
- Subadventitial dissection
- Partial resection with patch
- Total tubular resection with left heart bypass and graft interposition



Aortic Invasion

- Results:
- Tsuchiya et al. Ann Thor Surg 1994; 57:960.
 - 28 resections of lung tumors involving the aorta
 - 7 full thickness resections with aortic replacement: only 1 long term survivor
 - 21 aortic adventitial resections: 11 with incomplete resections that did poorly
- Ohta et al. JTCVS 2005; 129:804.
 - Combined resection of lung cancer and thoracic aorta in 16 patients
 - Operative morbidity 31% and mortality 12.5%
 - 5 year survival 70% for N0 and 16% for N2 or N3

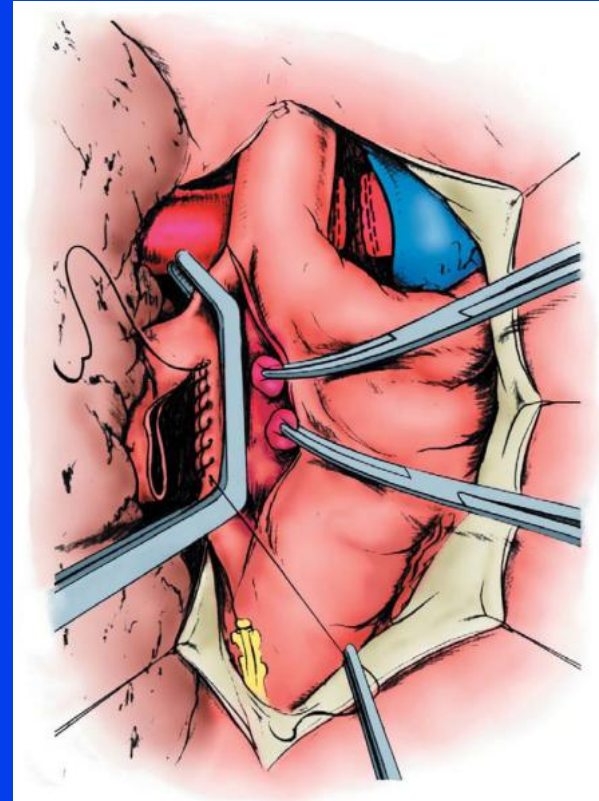
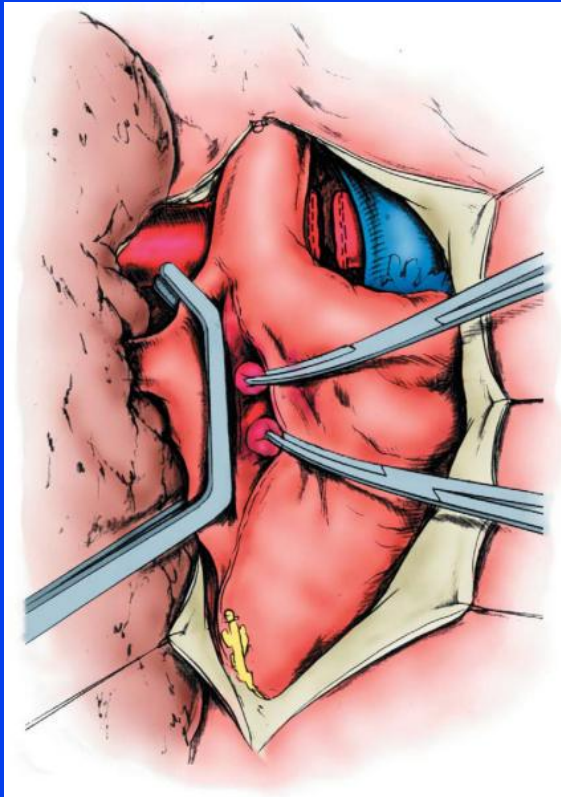


Left Atrial Invasion

- Limited reports of curative resection of lung cancers involving left atrium
- Opening interatrial groove can increase left atrial length and provide a margin for resection
- Ratto et al. Ann Thor Surg 2004; 78:234.
 - 19 left atrial resections
 - 5 year survival 14%, median 25 months
- Spaggiari et al. Ann Thor Surg 2005; 79:234.
 - 15 partial left atrial resections for lung cancer
 - 3 year survival 39%



Left Atrial Invasion



Spaggiari et al. Ann Thor Surg 2005; 79:234.

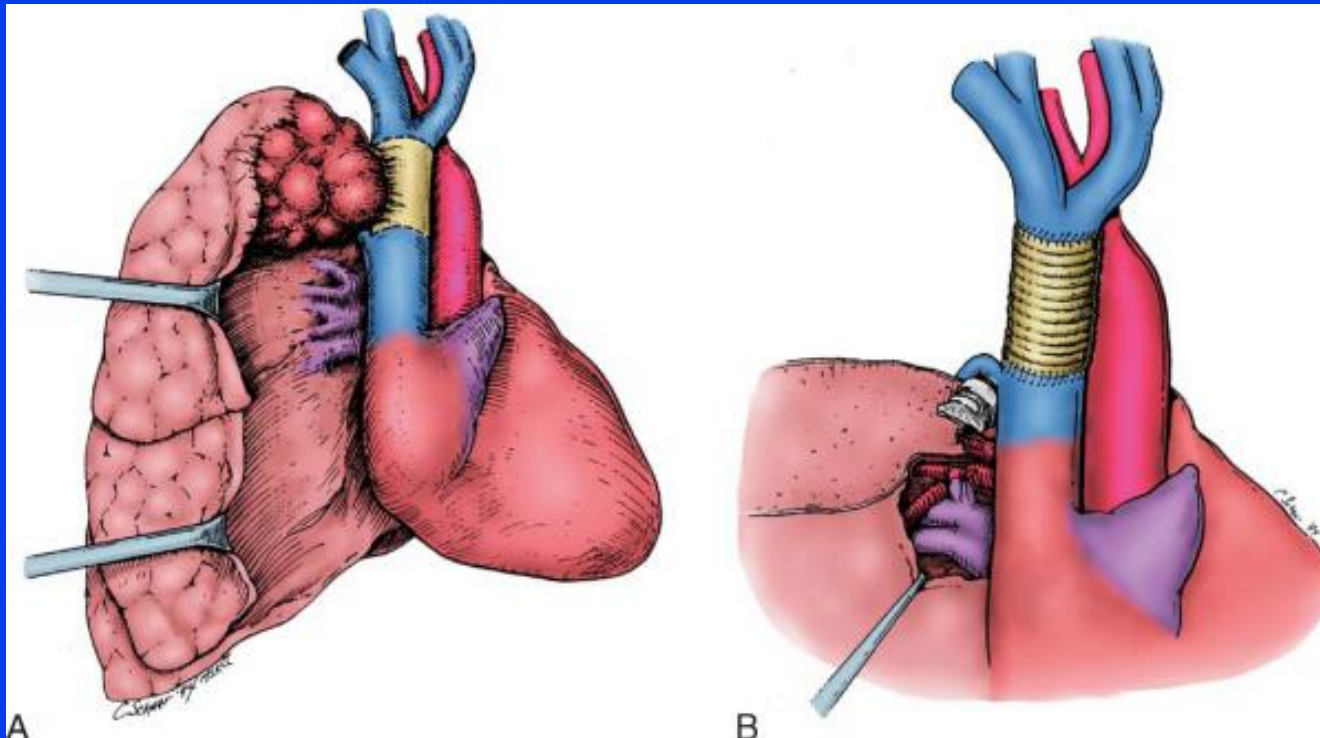


Superior Vena Cava

- Bronchogenic carcinoma may involve the SVC by direct extension
- Resection of SVC may be performed en bloc
- Minimal involvement: side biting clamp with partial resection +/- patch augmentation of SVC
- Circumferential resection: replace SVC with ringed Gore-Tex or fashioned bovine pericardial tube
- Minimize venous clamp times: decreases venous return and increases cerebral venous pressures



Superior Vena Cava



Pearson's Thoracic and Esophageal Surgery 3rd ed.



Superior Vena Cava

- Dartevelle PG. Ann Thorac Surg 1997; 63:12-19.
 - 14 SVC resections and replacements for NSCLC
 - 11 were squamous cancers
 - Overall survival 31% at 5 years
- Spaggiari et al. Ann Thorac Surg 2000; 69:233-236.
 - 25 SVC resections for NSCLC
 - 7 complete resections with graft interposition
 - 12 tangential resections of SVC, 1 augmented with pericardium
 - 5 resections of right innominate and subclavian veins without reconstruction
 - Operative mortality 12%, 5 year survival 29%



Pericardial Invasion

- Pericardial invasion by resectable lung cancer is uncommon
- If pericardial adherence noted, open pericardium away from phrenic nerve.
- If right pneumonectomy performed, close pericardial defect to prevent cardiac herniation
- Gore-Tex, Dacron, bovine pericardium and vicryl mesh may all be used to close pericardial defects



Esophageal Invasion

- Nodal spread is more common mode of esophageal involvement than direct invasion
- Resection of muscular wall of the esophagus leaving mucosa intact is acceptable for central lung cancers
- En bloc esophagectomy with a pulmonary resection cannot be justified based on the experience of any reported series



Conclusion

- Extended pulmonary resections are applied to T3 or T4 lung cancers
- Mandatory that all patients undergo extensive staging including mediastinoscopy prior to attempted resection
- Operative planning critical: only a complete resection gives a patient a chance for cure

