G.Missenard, C.Court, A.Dubory, E.Fadel.
South Paris University, France.

RESECTION OF THORACIC SPINE PRIMARIES TUMORS
Primary Malignant spine Tumors:

1/ Coming directly from spine constituents:
   - Bone and soft tissues sarcomas (surgical and/or medical treatment).
   - Hematological lesions (lymphomas or plasmocytomas = medical treatment).

2/ Coming from adjacent anatomical elements:
   - Sarcomas (Ribs, muscles, vessels, nerves, etc...)
   - Carcinomas (Lungs, Pleura, etc...)

Even if they are not primary spine tumors, spine resection is mandatory to obtain wide margins.
Anatomy and pathology.

- Many classifications were proposed for spine tumors, 3 seems useful.

1/ VBB: Complete but not very reproducible from an investigator to an other one. No indication for surgical technique.
2/ Surgical staging of vertebral tumor (Tomita)

Mainly interesting for:
- the tumor staging: **Extra compartmental** meaning soft tissues, spinal canal involvement or major thoracic organs extension.
- The tumor extension on the spine
Anatomy and pathology.

3/ We use the classification done for the staging of Pancoas tumors (ann thorac surg 2011) which is directly correlated to the surgical procedure and spine osteotomies:

- **A**: Transverse process involvement: Costotranversectomy.
- **B**: Root and foramen invasion: 1/3 sagittal hemivertebrectomy.
- **C**: Foramen and vertebra body invasion: 2/3 sagittal hemivertebrectomy.
- **D**: Massive vertebra body invasion: En bloc corporectomy.
Surgical Indications

- The only goal of this surgery is to provide en bloc resection with wide margins (You have only one shot!!).
- Contra indications (CI) are:
  - Spinal canal involvement at presentation or remaining after neo adjuvant treatment.
  - Massive adjacent organ involvement as big vessels, esophagus, etc..
Surgical Indications

- Pluridisciplinary approach is of major importance:
  - Preoperative chemotherapy allows a downstaging increasing safety margins.
  - Preoperative radiation therapy is often better than PO one:
    - More targeted.
    - Decrease the pleura cavity dissemination risk.
    - No disturbance by metallic devices.
    - Improve margins from R1 to R0.

Mesenchymous chondrosarcoma
Surgical Indications

- Anterior spinal arteries are not a CI but:
  - The vascular spinal cord risk increases with the number of resected levels (Europ journ of radiol 2011).
  - It is major after three vertebra body resection or five levels hemivertebrectomies.
  - In these cases, improvement of spinal cord vascularization must be done by CSF post operative drainage as shown for aortic surgery.
Surgical techniques

- **The rule** is to combine posterior approach (PA) with simultaneous or primary anterior one (AA).
- The techniques described by Roycamille or Tomita are obsolete and the best mean to have peroperative complications or contaminated margins or the both!
- AA could be done by thoracoscopy (T2 to T11), open thoracotomy (OT) or enlarged cervicotomy (EC) at the cervico thoracic junction (CTJ) or TPL at T12.
- The sequence is depending on the anterior involvement of major organ as lung or big vessels which could not be released by thoracoscopy.
- Thoracoscopy is also no possible when the patient has previous thoracic surgery.
Depending on the group ABCD, the Tomita stage (IC/EC) the anterior extension and if the patient has further thoracic surgery (FTS), Surgical procedure will be different.

<table>
<thead>
<tr>
<th>Anterior A GR+level+C</th>
<th>Thoscopy</th>
<th>Thoracotomy</th>
<th>Th PhrenoL</th>
<th>ENCertomy</th>
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<tbody>
<tr>
<td>BCD+T3/T11+ IC +No FTS</td>
<td>X+ SimultaneousPA</td>
<td>If FTS Th first and secondary PA</td>
<td></td>
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<tr>
<td>A+TI/T5 +EC</td>
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<tr>
<td>BCD +TI/T5+EC</td>
<td>P</td>
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<td>X+ 2E PA</td>
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<tr>
<td>BCD +T3/T11 +EC</td>
<td>X (no FTS) + PA</td>
<td>Or X major organ extension + PA</td>
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<tr>
<td>BCD T12 IC or EC</td>
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<td>X + second PA</td>
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Surgical techniques

- You must also anticipate the surgical team:
  - In my opinion these patients have better follow up in thoracic surgery center: you must operate the patient where it is more convenient to challenge the PO complications.
  - The association with the thoracic surgeon pushes out the limits of that surgery!!
  - Sometimes other surgeon is necessary:
    - Plastic surgeon for muscular flap or vascularized fibula.
    - Neurosurgeon if dura mater resection must be done.
Surgical techniques

*The reconstruction:*

A/ only costo transversectomy: no reconstruction.

B/ 1/3 hemi vertebrectomy: posterior fixation with PL arthrodesis.

C/ 2/3 hemivertebrectomy: posterior fixation with PL arthrodesis +/- anterior fitting with graft.

D/ En bloc corporectomy: posterior fixation with PL arthrodesis + anterior fitting with graft or cage + anterior fixation.
Surgical techniques

- **The reconstruction:**
  - The spine junctions, especially the CTJ one are of critical importance.
  - All our mechanical problems occurred in these areas.
  - At the CTJ in case of HV, posterior fixation is enough but must be associated to C7/T1 anterior inter body arthrodesis.
  - At the Thoraco lumbar junction the posterior fixation must be extended to L1 or L2.
Discussion on clinical cases (from easier to the most difficult one)

- 42 y Female patient with malignant pleural carcinoma involving the T9/T10 right foramen (Type B +IC) The lesion is small but close to the dura mater so to improve the margins preop chemo is done with a nice result:

After three courses
En bloc resection was decided: there is no anterior extension to major organs (Type B IC) so the patient has extensive posterior approach with simultaneous thoracoscopy on Hall frame. 1/3 vertebrectomy on two levels, reconstruction by posterior fixation with arthrodesis (Four hours surgery). The patient is CDF with 4 years of FU.
66 years old male patient presenting a chondrosarcoma of T4, the involvement of the left lamina and pedicle allows only a small access to the spinal canal, the tumor is type C+ EC but without major organ extension leading to type C resection (2/3 hemivertebrectomy on 3 levels) with thoracoscopy. (six hours of surgery)
The reconstruction was done with posterior fixation and arthrodesis. The ct scan control at six years of FU shows no LR and no mechanical problem.
52 years old female patient presenting a Pancoast tumor with spine (T1 to T3) and sub clavian artery involvement (type B extracompartimental). Anterior approach is firstly done for anterior release, lobectomy and artery replacement. After the patient is turned in prone position for en bloc resection of spine, lung and vessels (8 hours surgery)
Anterior release and landmarks

Hemivertebrectomy and specimen removal.
The reconstruction was done by posterior fixation and C7/T1 anterior arthrodesis, done during the anterior approach.

Po Xrays and patient aspect

5 years po MRI
58 years old patient presenting a chondrosarcoma of
T8(TypeD+EC) he was treated firstly by laminectomy, so
preop RXTH was done because wound contamination: En
bloc resection of three vertebrae was done by posterior
approach + thoracoscopy even the tumor was extra
compartimental (seven hours of surgery)
Anterior spinal artery was found in T8 left and sacrificed during the procedure, but the patient has good AK artery in L1.

The thoracoscopy helps to gigli saws exact situation.
The resected specimen showed wide margins, due to extra compartmental excision with the pleura and spine anterior and posterior ligaments.

Importance of anterior thorascopic control to avoid retropleural resection.
Reconstruction was done by fitting the anterior loss by a spacer with autologous bone associated with anterior and posterior fixation. Posterior fixation alone in total vertebrectomy gives a 50% rate of pseudoarthrosis! The patient is CDF with 9 y of FU.
45 years old female patient presenting a multiple exostosis disease (MPE), She has a chondrosarcoma coming vertebra exostosis Type D +EC. Pluridisciplinary surgery was decided: thoracic + orthopaedic + plastic surgeon. **The question was: which way to pull out the spinal cord?** So pre op discussion with the radiologist was important to find a safe area.

The strategy was to do first anterior release by wright thoracotomy, to open anteriorly the spinal canal and to mobilise the spinal cord with 5 pairs of roots ligation and secondary posterior approach to remove the specimen (13 hours of surgery).
This is the peroperative view after specimen removal, the spinal cord was protected against the lung pressure by a metallic blade. Reconstruction was done by anterior and posterior fixation, anterior fitting with an allograft and vascularized rib, posterior coverage by latissimus dorsi flap. Immediate postoperative neurological status was normal but at 36 hours the patient developed progressive paraplegia, it was cured by CSF drainage indicated by the thoracic surgeon! HE SAVED the cord of this patient.
This patient is always alive and CDF six years after the surgery, she is working normally and the back aspect is good. She has only one reoperation for posterior left rod removal. A medical investigation was done on her family because of MPE.

Her uncle died after unresectable chondrosarcoma of the thoracic chest, her father was operated of proximal femur chondrosarcoma with endolesionnal resection and very important local recurrence leading to external pelvectomy.
This the father CT scan of the pelvis, the discussion with the radiologist was very useful to assess the exact localization of the bone osteotomies to obtain wide margins due to multiple exostosis!

Bony sections were done in the symphysis and the sacrum allowing wide resection with very mutilating surgery due to further poor surgery.!!!
Her son has a big exostosis developed on the pelvis, the aspect was a chondrosarcomas transformation leading to en bloc resection without biopsy. The pathologist report showed it is a chondrosarcoma Grade I.

ALL patient with MPE must have at the adult age a Total body CT scan to track the trunk lesion able to further transformation ++++
Conclusion I

- Using our classification and the Tomita one it is easy to propose a surgical strategy:
- The classification between fours groups helps you to design the bone osteotomies and also to planify the reconstruction.
- The stage intra or extracompartmental with or without major anterior organ extension is useful to decide which and when must be done the anterior approach.
- Further thoracic surgery is a contra indication to thoracoscopy.
- There is no place for improvisation!!
Conclusion II.

- Thoracic spine primaries tumors must be treated in a pluridisciplinary center.
- The association with the thoracic surgeon improve dramatically the quality of the excision and the follow up of the patient.
- The preoperative planning must be done a long time before the surgery to plan the procedure, the reconstruction and the surgical team.
- The tumor orthopaedic surgeon must be able to treat also the other localizations like pelvis or limbs to assess global take care of these patients.
- YOU Have only one chance to cure the patient.
Conclusion III

- One Shot surgery needs a long training

The Master
And
his disciple

Thank you
Jean