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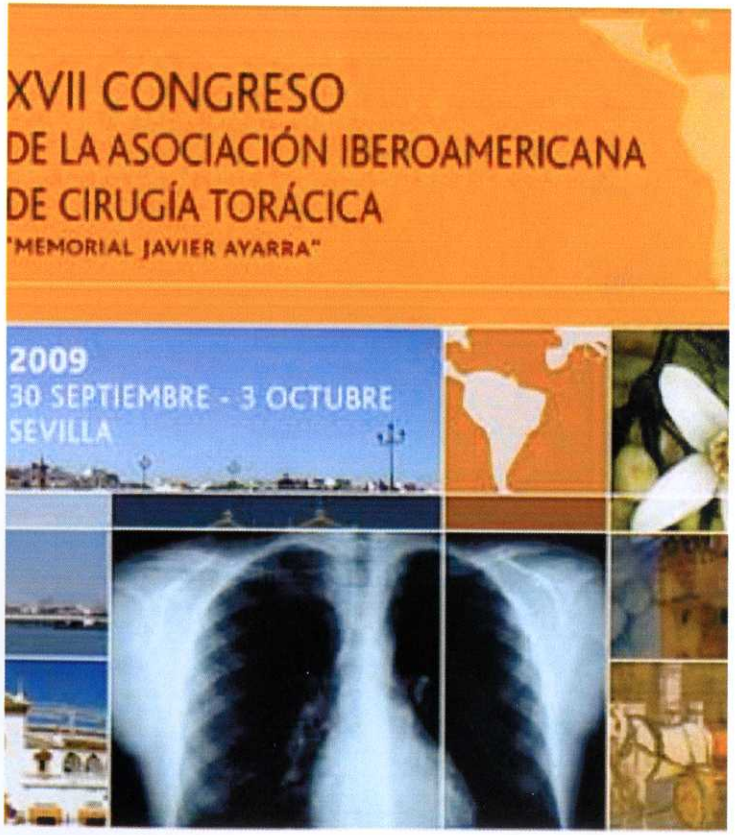

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TRACHEAL SLEEVE PNEUMONECTOMY FOR T3 LUNG CANCER WITH INVASION OF CARINA

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Surgical excision is regarded as the treatment of choice for lung cancer; however, radical surgical treatment in the case of locally advanced lung cancer is still debated. The majority of neoplasms invading the carina or the lower trachea are extensive and unresectable, however in a limited number of cases they are localized enough to be amenable to curative resection even if their removal is a great surgical challenge.

To overcome the difficulty in resecting this kind of tumor, Gibbon in 1959 devised a personal technique

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and presented his first cases of tracheal sleeve pneumonectomies. A few other sporadic attempts by other surgeons using different modified techniques were reported in literature during the following years.

In 1972 Jensik and coworkers presented the first consistent series of 17 patients subjected to this technique; in 1982 the same authors updated the series to 34 patients, with a perioperative mortality of 29%. Other famous surgeons presented their important results but always with high mortality rates, ranging between 15 and 31%.

Tracheal Sleeve pneumonectomy is the resection of the carina and the lower trachea and the ipsilateral lung, followed by the anastomosis between the opposite main-stem bronchus and the lower trachea.

The operation is almost exclusively performed on the right side because tumors on the left side rarely meet the correct criteria for tracheal sleeve pneumonectomy.

As a matter of fact, tumors of the left main stem bronchus almost always invade the structures of the subaortic space. Furthermore, left tracheal sleeve pneumonectomy is a much more complicated and demanding procedure with a greater occurrence of postoperative complications.

TSP is considered a high-risk operation and for this reason an accurate selection of patients, a meticoulos precision in surgical technique and an optimal post-operative care are mandatory.

In the last thirty years important progresses in anaesthetic techniques, suture materials and drugs led to change the guidelines of TSPs which, nevertheless, are still carried out only in few centers.

Tracheal sleeve pneumonectomy is an aggressive procedure for resecting bronchial carcinomas involving the tracheobronchial angle, carina, or lower trachea. We now perform tracheal sleeve pneumonectomy in non–small cell lung cancers invading the main bronchus that are less than 2 cm distal to the carina or that arise at the tracheobronchial

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angle and extend along no more than 3 cartilaginous rings on the distal tracheal wall.

Indications for left tracheal sleeve pneumonectomy remain exceptional and limited to relatively young patients with a low degree of malignancy, who therefore have a good chance of survival. Reports of left tracheal sleeve pneumonectomy in the literature are rare in comparison with the total number of tracheal sleeve pneumonectomies.

Some authors consider proven N2 disease a contraindication to TSP, others suggest that limited N2 disease can be downstaged by induction therapy, however the majority of authors reports increased mortality and morbidity as well as decreased survival in patients treated by induction therapy in comparison with N0 – N1 patients.

According to the majority of Authors the maximum extent of tracheal resection should be limited to 4 cm.

Superior vena cava infiltration is no longer considered an absolute contraindication to resection even if

experiences are even more limited. Recent papers declare that in selected patients resection of SVC is feasible with concrete good results.

All patients must be submitted to routine preoperative staging to define the extrabronchial extent of the lesion and to exclude distant metastases. This normally includes bronchoscopy, chest, upper abdomen and brain CT, and functional tests. PET, at present, is carried out in all patients. The role of routine mediastinoscopy is debated, and, especially after the introduction of PET scanning; we perform it only in selected patients.

Step by step description of the surgical technique is beyond the scope of this paper however some technical issues worth discussion.

All surgical interventions have been performed with the same surgical technique, but ventilation technique altered over the years until 1987, when we adopted the present technique. Since 1987 we have used the Sibilla Fome-cuf tube produced by Bivona Inc. (Gary, Ind), which greatly facilitates surgical manoeuvre while

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ventilating the remaining lung during tracheo-bronchial anastomosis. This is a slender, silicon reinforced tube, 5–6.5 mm in diameter and 45 cm in length, with a self-expanding polyurethane foam cuff located at 1.5 cm from the tip.

The patient is intubated with a double-lumen Carlens tube. Through a posterolateral thoracotomy incision the distal trachea and carina are mobilized, and 4–5 cm of the anterior aspect of the trachea are dissected. Two traction threads are placed around the trachea and left main bronchus. The left main bronchus is severed at the second bronchial ring, intubated, and transiently ventilated from the operative field with a 6-mm Portex Tube (Concor/Portex, Keene, NH). The affected lung is removed en bloc with the carina and a stiff lead is inserted through the Carlens tube from the operative field. The anesthetist then withdraws the Carlens tube and replaces it with the Sibilla tube, which is then positioned in the left bronchus by the surgeon. The anastomosis is then carried out by placing interrupted stitches knotted on the outer side

of the bronchus and about 3mm apart on the trachea, starting from the deeper ones.

The ventilation tube is then retracted above the suture line and a hydropneumatic test is carried out. Usually we do not wrap the anastomosis with viable tissue. Lymphadenectomy of carinal, paracaval, and paratracheal lymph nodes is routinely carried out. The patient is extubated in the theatre after bronchoscopic evaluation of the anastomosis and vocal chord mobility.

Other Authors prefer a median sternotomy approach and the use of jet ventilation while performing the anastomosis.

Personal experience

From 1983 through December 2007 we observed 104 patients with lung cancer originating less than 2 cm from the tracheo-bronchial angle or invading the carina, candidates to TSP. All patients underwent routine preoperative staging including CT brain, chest and abdomen, bronchoscopy, pulmonary

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function tests and bone scintigraphy. Mediastinoscopy was done only in selected patients. Since 1993, in our institution all patients with operable lung cancer at any stage undergo thoracoscopy as the first step of the operation to rule out undetected conditions of inoperability. Out of 104 patients candidated to TSP, 37 (35.6%) were considered to have inoperable disease after conventional staging. Of the other 67 patients (64.4%) eligible for surgery, VATS revealed 5 pleural carcinomatoses without pleural effusion. Thoracotomy revealed 5 vena cava infiltration and 1 pulmonary artery infiltration. Therefore 11 patients (16.4%) had only an exploratory operation. Among the remaining 56 (83.6%) patients we performed 55 right tracheal sleeve pneumonectomies and 1 left tracheal sleeve pneumonectomy. Of the 67 patients eligible for TSP, 19 (28.4%) received preoperative radiotherapy (17 patients had low dose -30Gy- radiotherapy, and 2 had high dose radiotherapy), 7 (10.4%) had induction chemotherapy and 41 (61.2%) had no neo-adjuvant therapy. Histology confirmed 35 (62.5%) squamous

cell carcinoma, 19 (33.9%) adenocarcinomas, two (3.6%) adenoid cystic carcinomas.

We observed no intraoperative deaths and four perioperative deaths (7.1%). One patient died of myocardial infarction on po-day 22. Another patient died of congestive cardiomyopathy on po-day 8. The two patients who had received high dose radiotherapy died of non cardiogenic pulmonary edema on po-day 2 and of gastric ulcer haemorrhage associated with bronchial fistula on po-day 22. In the later case the small fistula had caused no respiratory distress.

Postoperative complications arose in 11 patients (19.6%). Among these, one developed ARDS resolved after tracheostomy and 3 months of assisted ventilation, another developed an early respiratory failure. Two developed an anastomotic fistula cured conservatively. One patients had transient recurrent nerve palsy and two developed an empyema without bronchial fistula. Cardiac events happened in 2 cases, digestive tract bleeding and controlateral pneumonia in one case. At follow up 56.6% of patients are alive

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and disease free 23-97 months after surgery. There were 21 deaths related to disease between 6 and 54 months after surgery (9.4% due to mediastinal recurrence and 30.2% due to distant metastases). Two patients died of a road accident 13 and 42 months after the operation.

Discussion

Only few teams in the world carry out this demanding operation. For this reason limited information are available on long term results of the procedure.

Intraoperative mortality reported by initial experiences is no longer present in more recent series, and perioperative mortality ranges between 7 and 15%; the same as after conventional pneumonectomy.

ARDS is the most dreaded complication and seems not attributable to technical mistakes; it can be observed in up to 22% of patients and can carry a mortality of 50%. Reduced fluid administration can minimize the risk.

Survival rates reported in literature are similar to those after conventional pneumonectomy for locally advanced tumors. Accurate selection of patients reduces the incidence of complications. High dose preoperative radiotherapy is considered a major determinant of postoperative complications; on the other hand low dose radiation can increase the number of patients amenable to resection and in our series did not increased the complications rate.

Conclusions

TSP is the only concrete treatment for patients with locally advanced cancer at the tracheobronchial angle. Complications can be reduced with accurate selection of patients and meticulous technique. Long term survival is equal to survival after conventional pneumonectomy for locally advanced cancer. Once a radical resection has been carried out the major determinant of long term survival is lymph node status.

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