TachoSil SEALANT MATRIX

Clinical Cases
Thoracic Surgery

corzamedical

www.corza.com

TachoSil® — Clinical Cases Thoracic Surgery

1 Uniportal robotic resection of the first rib

Serratosa I, Ureña A

Hospital Universitari de Bellvitge, L'Hospitalet de Llobregat, Barcelona

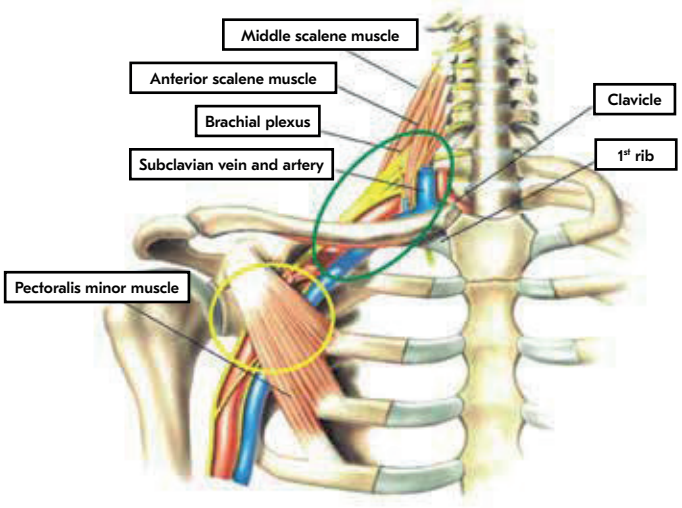


Image 1: The narrow cervicoaxillar is comprised of a proximal division, formed by the scalene triangle and the costoclavicular (in green in the drawing), and a distal division compounded by the axilla (in yellow). The proximal division is the most susceptible to the vascular-nervous compression.

Introduction

Known as thoracic outlet syndrom[2], symptoms that are produced as a consequence of the compression of the brachial plexus and/or the subclavian vessels at the thoracic outlet, due to anatomic or muscular variations. These variations may be due to developmental abnormalities, wounds, repetitive physical activity or inflammation, predisposing to local narrowing.

The tightness may occur at three levels in the path of the brachial vascular nerve bundle: The intercostal-scalene triangle, the costoclavicular space or the retro-coraco-pectoral space *(→ Image 1).*

Approximately 90 % of the manifestations are neurological[3], in the form of pain, hypoesthesia and dysaesthesia, weakness and vasomotor changes in the affected extremity. The vascular complications are less frequent, predominately veinous affectation, in 3–5 % of the cases, manifested as deep thrombosis[3]. Very rarely arterial compression occurs, giving way to distal isquemic phenomenon.

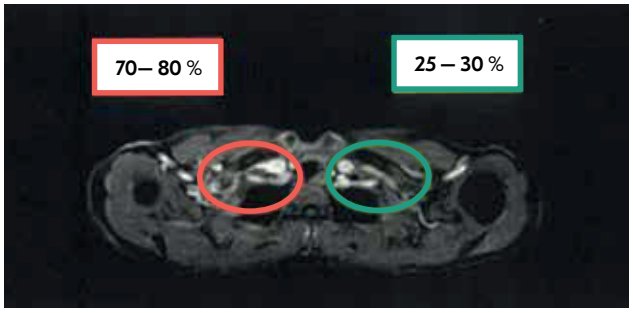


Image 2: MRI of the patient with arms in forced abduction, axial slice. A stenosis of 70 – 80 % of the right subclavical vein is calculated (marked in red), while the left subclavical vein presents a light reduction of only 25 – 30 % (in green).

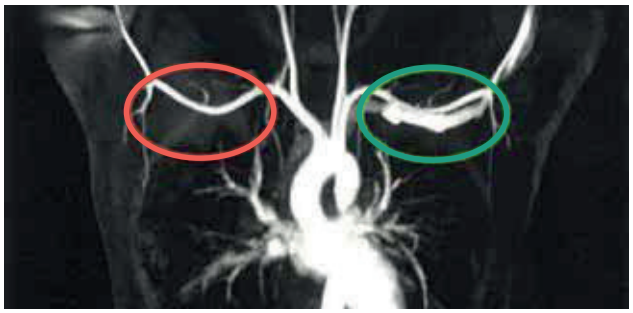


Image 3: MRA of the patient with the arms in forced abduction coronal section. Stenosis of the right subclavian vein is present (marked in red), in comparison the with left subclavian vein (in green).

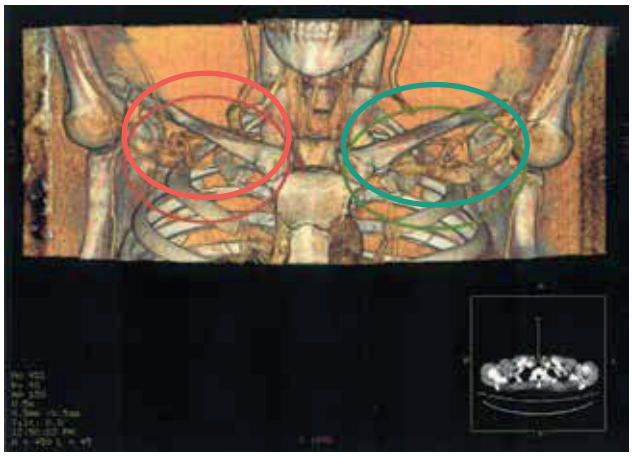
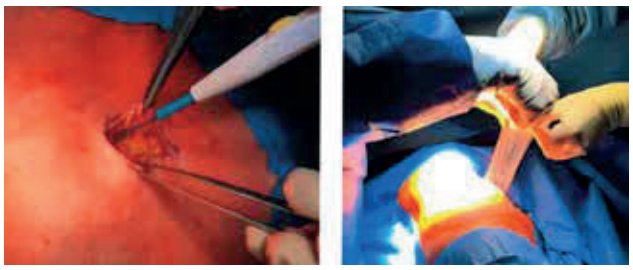


Image 4: Reconstruction of the MRA of the patient with the arms in forced abduction coronal section. The right subclavian vein can be seen as practically totally obliterated (the region where it should be located marked in red), with respect to the left subclavian (marked in green and easily identifiable in the image).



Images 5 and 6: Unique incision in the 5th intercostal space, anterior axillary line.

The diagnosis is predominantly clinical. It is based on a series of maneuvers that demonstrate the characteristic signs of this condition, by tightening the passageways of the neurovascular elements through the thoraco-clavicular gorge.

In addition, the diagnosis tends to be supported by the measurement of the speed of the cubital nerve conduction velocity, that corresponds well with the clinical symptoms. Any value lower than 70 m/s reflects vasculonervous compression, whose severity can be classified according to the decline of the conduction velocity.

Finally, image tests are very useful to locate and characterize the anatomical points that exercise the greatest compression on the subclavian vessels and the brachial plexus.

With respect to treatment, most patients affected by this syndrome benefit from conservative treatment and physical therapy. However, a small percentage may require surgical resection of the first rib and the correction of other bone abnormalities to relieve the symptoms[3].

Clinical case

Female patient, 39 years old, with deep vein thrombosis (DVT) in the upper right extremity with vascular redistribution, neurovascular involvement and positional pain.

Her pathological history includes surgical intervention (thoracoscopy) for palmar hyperhidrosis 15 years ago, and another DVT in the upper right extremity in 2010, when she received limited anticoagulant treatment. Currently, reappears with clinical compatibility for DVT in the same region, so more studies are prescribed.

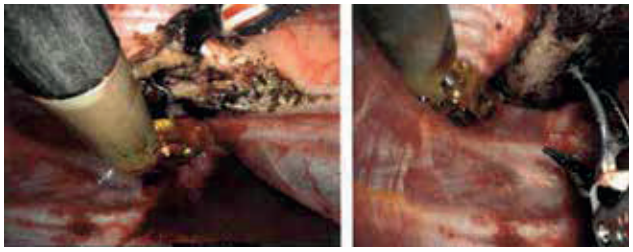
In CT angiography a notable reduction in the costo-clavicular space in abduction is detected (5.8 mm) with respect to the anatomic study (8.8 mm).

In MR the upper extremity shows a light reduction of 70 – 80 % in the right subclavian artery *(→ Image 2)*.

In MRA presents "marked stenosis of the right subclavian artery in the costoclavicular space with forced abduction maneuvers, without signs of thrombosis and complete recovery at rest *(→ Images 3 and 4)*.

The electromyogram is normal.

Image 7: Robotic trocars placed in the unique incision.



Images 8 and 9: Dissection of the first rib.

Image 10: First rib isolated.

Image 11: Reconstruction of the passage of the right subclavian vascular-nerve bundle over the first rib.

After performing symptomatic, physiotherapy and rehabilitation treatment, and given the recurrence of DVT after 15 years, surgery of the thoracic cavity is recommended.

On 10/28/2021 uniportal robotic surgery was performed on the 1st right rib.

With the patient in left lateral decubitus, an incision of approximately 4 cm was made in the fifth intercostal space between the anterior and posterior axillaries, introducing the three robotic trocars through the opening *(→ Images 5, 6 and 7)*. Abundant presence of pleuropulmonary scars due to the prior surgery. The first right rib was dissected *(→ Images 8, 9 and 10)* and the right subclavian vascular-nerve bundle was identified, carefully performing dissection of the same *(→ Image 11)*. Afterward the first rib was dissected almost in its entirety *(→ Image 12)* and hemostasis was performed using TachoSil® in the bed of the dissection *(→ Images 13 and 14)*. The intervention was finalized with the insertion of a drainage tube of 28Fr and the closure of the ostomy with intradermic sutures *(→ Image 15)*. The patient was able to be discharged on the third postoperative day, with good pain control and a regimen of prophylactic anticoagulant, with the objective of eliminating it on the next control visit.

Discussion

The initial treatment of thoracic outlet syndrome is conservative, but the persistence of significant symptoms, that affect around 5% of the patients, indicates the resection of the first rib.

Different techniques for the surgical treatment of patients with thoracic outlet syndrome have been described: open surgery, assisted by video (VATS) and assisted by robot (RATS).

The VATS demonstrated certain advantages compared to the open abroach, such as amplified vision of the length of the first rib and better identification of the vascular-nerve bundle.

RATS arose afterwards, initially with four ports facilitating the rapid dissection of narrow outlets, improving the maneuverability and the visualization using 3D vision, with respect to the instruments of conventional video thoracoscopy.

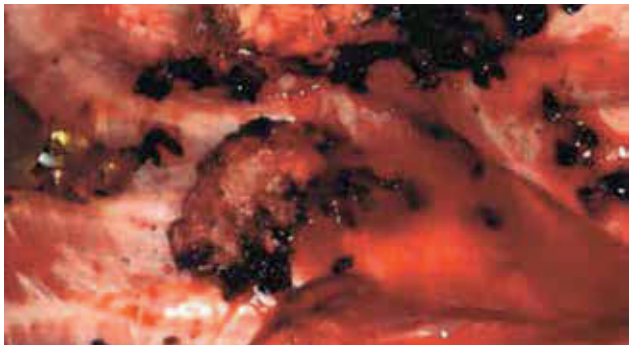


Image 12: First rib resected practically in its entirety.

Image 13: Placement of TachoSil® in the thoracic cupula.

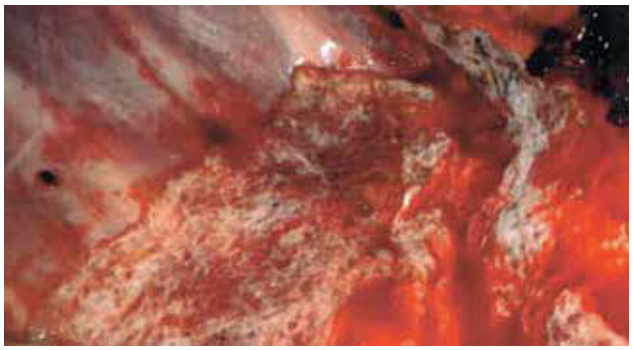


Image 14: Hemostasis with TachoSil® in the surgical bed.

Image 15: Endothoracic drainage and ostomy closure.

Progressive improvement of the robotic technique has been attempted, reducing the ports necessary for the resection of the first rib, just as has been postulated by Zehnder et al., that perform the procedure with three incisions[1].

However, we present the first case in the world where the surgical treatment of the thoracic outlet syndrome has been performed using uniportal robot assisted surgery (URATS). This has permitted combining the ergonomic advantages of the robot with reduced tissue damage by carrying out the procedure through a unique intercostal space, which at the same time produces better postoperative results and lower morbidity.

The objective is to continue perfecting the surgical technique of this benign pathology, in order to allow the affected patients to benefit from a the least invasive surgery with the most security.

BIBLIOGRAPHY

1. **Zehnder A, Lutz J, Dorn P, et al.** Robotic-Assisted Thoracoscopic Resection of the First Rib for Vascular Thoracic Outlet Syndrome: The New Gold Standard of Treatment?. J Clín Med. 2021;10(17):3952. Published 2021 Aug 31.
2. https://pubmed.ncbi.nlm.nih.gov/7474759/
3. https://journals.lww.com/jaaos/Fulltext/2015/04000/Thoracic_Outlet_Syndrome.4.aspx

2

Use of TachoSil® hemostatic matrix for the control of thoracic aorta bleeding

Saumench Perramon R[1], Cladellas Gutiérrez E[2]

1 Hospital Universitari Mútua Terrassa; 2 Hospital de la Santa Creu i Sant Pau

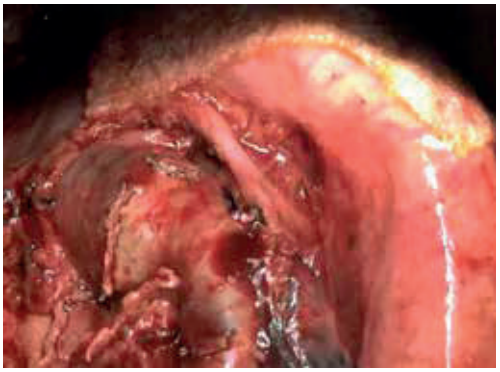


Image 1: LUL lobectomy with TachoSil® hemostatic matrix in the aortic arch.

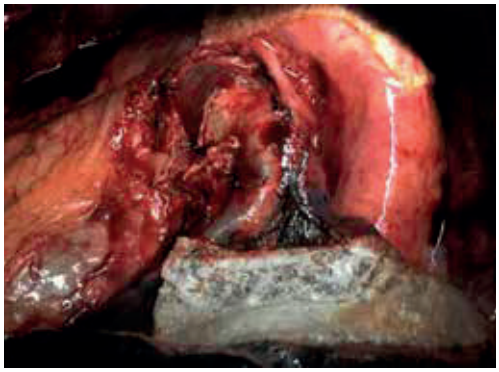


Image 2: LUL lobectomy with TachoSil® hemostatic matrix in the aortic arch and second TachoSil® aerostatic matrix over the pulmonary parenchyma on the cisural side of the left upper lobe.

Introduction

Different articles publish the efficacy and security of the use of hemostatic and aerostatic matrices in bleeding and airway leakage in cardiothoracic surgery[1-4].
Here we present the case of bleeding at the level of the thoracic aorta and the use of TachoSil® hemostatic matrix during a pulmonary resection surgery.

Clinical case

Male patient of 61 years of age with history of tuberculosis in his youth and reactivation in 2001 treated with tuberculostatics during 6 months, EPOC, Anxiety Syndrome during treatment, anemia and rectal bleeding in follow-up by the gastroenterology unit, that is diagnosed as pulmonary adenocarcinoma in left upper lobe (LUL) cT2bNOMO a result of toxic syndrome, cough with purulent expectoration and associated dyspnea.

As complementary explorations to complete the study, the following were performed:

PET-CT in which a mas of 47 mm is observed in LUL, with cavitated core and significant hypermetabolism (SUV max. 14.9 g/ml) compatible with primary pulmonary neoplasm. Adenopathies in lower right and subaortic paratracheal regions, measuring < to 1 cm, with discreet metabolic activity (SUV max. 2.1 g/ml) suggesting an inflammatory/reactive type of pathology.

Bronchoscopy: exploration within normal limits. Cytology positive for adenocarcinoma.

Functional respiratory tests:
FVC 3.48L (86 %), FEV1: 1.91L (64 %), FEV1/FVC 55 %, DLCO 57 %, DLCO/VA: 63 %.

Scintigraphy ventilation/perfusion:
QPD: 56.88 % (third S 5.29 %/third M 26.83 %/ third 1 24.75 %). QPE: 43.12 % (third S 7.12 %/third M 23.20 %/1/3 12.81 %).

PFR post-operatory calculation:
FEV1: 61.2 %, DLCO: 46.4 %.

To complete the extended study a staging mediastinoscopy was performed, in which biopsies of the paratracheal adenopathies of the lower right and left and subcarinals of both were obtained, all of which were negative for malignancy.

The patient is scheduled for an upper left lobectomy. At the beginning of the surgery, during the removal of multiple firm adhesions, the retraction of an adhesion located between the aortic arch and the LUL parenchyma provokes a pulsatile jet bleed originating from the aortic arch. Due to the aortic calcification present, to attempt to avoid the performance of a suture point that could produce a greater laceration at that level, compression with gauze was performed during 10 minutes. After which the pulsatile bleed diminished to sheet bleeding, which within this context the procedure of the placement of the TachoSil® hemostatic matrix *(→ Image 1)* was carried out, performing compression with humid gauze during 5 minutes on it and the bleeding was reduced to proceed with the performance of the scheduled pulmonary left lower lobe resection surgery. The left superior lobectomy and systematic hyilomediastinal lymphadenectomy were completed without further incident. The intervention ended without evidence of new bleeding. At the same time a second matrix was placed with aerostatic intention over the small laceration in the parenchyma on the cisural side of the left lower lobe *(→ Image 2)*. The patient's postoperative period transpired without complications being discharged at 5 days after the intervention. The definitive pathologic anatomy was compatible with adenocarcinoma with a predominantly acinar pattern with areas of a solid pattern (30 %), and micro papillary (20 %) of 6.8 cm in diameter in LUL that infiltrates the visceral pleura with angiolymphatic invasion and without perineural invasion, free borders, adenopathies without evidence of metastasis (0/9) pT3NOMO type IIb. Ambulatory remittance to oncology doctor to evaluate systemic adjuvant treatment with cisplatin — vinorelbine.

Discussion

Surgical bleeding during pulmonary resection surgeries is one of the potentially severe complications that can be life threatening to the patient. These bleeds, be they in minor or mayor amounts, can originate from the large vessels (veins and pulmonary arteries, aorta, superior vena cava), the small to medium caliber vessels (azygos vein and braquial arteries) or from the pulmonary parenchyma and the thoracic wall. The usefulness of the hemostatic matrixes has been demonstrated in all of them[1,2].

In the case we presented a small lesion in the thoracic aorta occurred during the efforts to liberate secondary adhesions probably due to the prior tuberculosis process. The use of the hemostatic matrix permitted the containment of the bleeding to be able to proceed to the pulmonary resection and avoided the need to perform a suture on a vessel with calcified atheroma plaques, since performing a suture point on a calcified aorta carries the risk of generating a greater tear in the same. In our case, we also applied the matrix for other of its indications demonstrated[1,3,4] such as the air leakage of the pulmonary parenchyma.

BIBLIOGRAPHY

1. **Lorusso R, De Cicco G, Vizzardi E, Gelsomino S.** Human fibrinogen/thrombin-coated collagen patch to control intraoperative severe pulmonary hemorrhage and air leakage after correction of a ruptured thoracic aortic aneurysm. Ann Thorac Surg. 2011 Mar;91(3):917-9. doi: 10.1016/j.athoracsur.2010.08. 015. PMID: 21353031.
2. **Maisano F, Kjaergard HK, Bauernschmitt R, Pavie A, Rábago G, Laskar M, Marstein JP, Falk V.** TachoSil® surgical patch versus conventional hemostatic fleece material for control of bleeding in cardiovascular surgery: a randomized controlled trial. Eur J Cardiothorac Surg. 2009 Oct;36(4):708-14. doi: 10.1016/j.ejcts.2009.04. 057. PMID: 19595605.
3. **Zhou J, Lyu M, Pang L, Gao Y, Ning K, Wang Z, Liu L.** Efficiency and safety of TachoSil® in the treatment of postoperative air leakage following pulmonary surgery: a meta analysis of randomized controlled trials. Jpn J Clin Oncol. 2019 Sep 1;49(9):862-869. doi: 10.1093/jjco/hyz076. PMID: 31135918.
4. **Marta GM, Facciolo F, Ladegaard L, Dienemann H, Csekeo A, Rea F, Dango S, Spaggiari L, Tetens V, Klepetko W.** Efficacy and safety of TachoSil® versus standard treatment of air leakage after pulmonary lobectomy. Eur J Cardiothorac Surg. 2010 Dec;38(6):683-9. doi: 10.1016/j.ejcts.2010.03.061. Epub Jun 11, 2010. PMID: 20541949.

3

Right pneumonectomy with left atrium resection in a patient with an endodermal sinus tumor

Minasyan A, García Pérez A, Sánchez Valenzuela I

Hospital Clínico Universitario de A Coruña

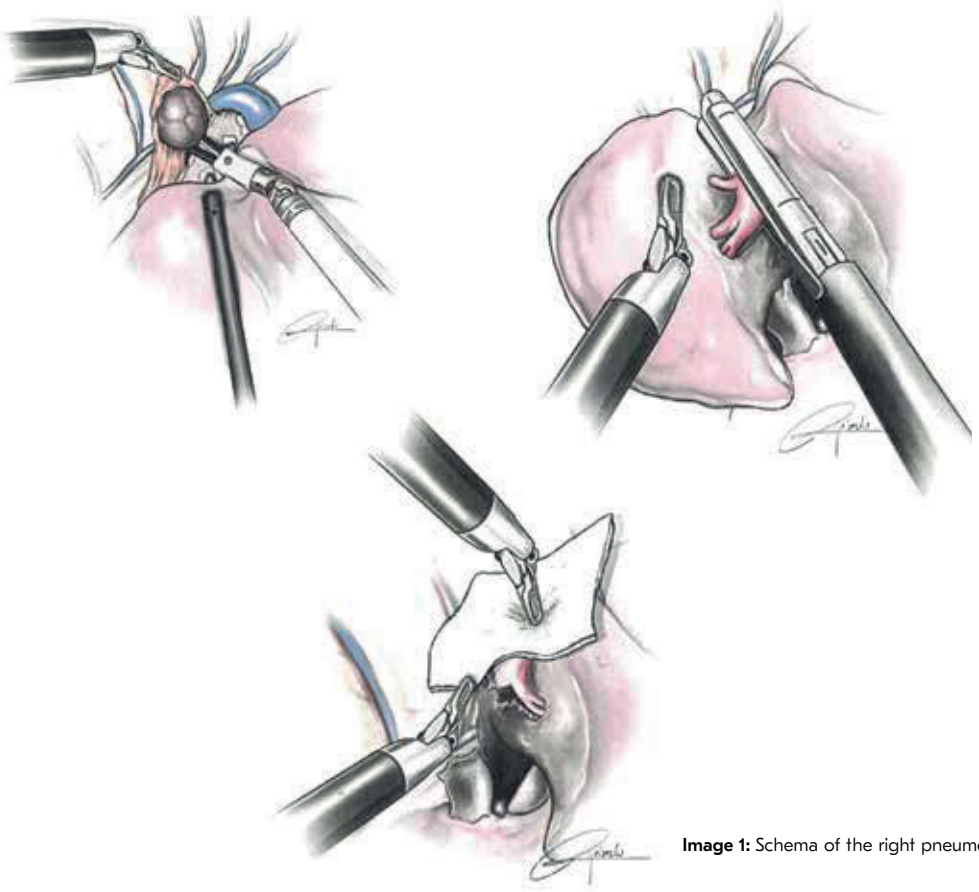


Image 1: Schema of the right pneumonectomy.

Introduction

Primary lung tumors with extragonadal germ cells are infrequent and the pure pulmonary yolk sac tumor is so uncommon that it is rarely included in the differential diagnosis of pulmonary masses[1]. There are few cases described in the literature, limited to a few cases of choriocarcinomas and rare endodermal sinus (Yolk Sac) tumors[2,3]. In this article, we present a clinical case of a primary endodermal sinus lung tumor and its posterior treatment using surgical resection.

Clinical case

Male of 47 years of age, is admitted to the Oncology Service with symptoms of approximately 4 months of evolution consisting in right subcostal pleural pain, dyspnea on moderate exertion, irritating cough, vomiting, coughing and constitutional syndrome (asthenia, anorexia and loss of weight of about 15 kg). Among his personal background it is to be noted that he had started smoking when he was 16 years old, smoking 10 — 15 cigarettes/day (accumulated consumption 20 packs/year) as well as cannabis. Inhaled cocaine consumption every 2 — 3 weeks. Severe bullous emphysema and diverticula in sigma, A thoracoabdominal not pelvic CAT is performed finding a bilobular mass of 16 x 10 x 12 cm (CC x TR x AP) in the right posterior hemithorax very heterogenous enhancement, compatible with neoplasia. The lesion compresses and displaces anterior to the heart and the structures of the right pulmonary hilum, encompassing the inferior lobar bronchi (conditioning partial atelectasis of the ILB) posterobasal branches of the pulmonary artery of the ILB, not discarding infiltration of said structures. Blood analysis reveals an increase in the alpha-fetoprotein (afp) 36,130.7 ng/ml.

Afterward a guided biopsy of the pulmonary mass with ECO is performed and the sample is sent to pathologic anatomy, with the result of the yolk sac with extended areas of hepatoid pattern (IHQ+: AE1/AE3, alphafetoprotein, SALL-4, glipican-3, CDX-2 and hepatocyte) and focal areas of the glandular pattern (IHQ+: AE1/AE3, alphafetoprotein, SALL-4, MOC-31 and CK7); (IHQ-: p40 synaptophysin, TIF-1, CK20, CK5/6, CD30, napsine, OCT-4, CD117, arginase-1 and PLAP) amoydx Pan Lung Cancer PCR Panel (EGFR, ALK, rosl, KRAS; BRAF, HER2, RET, MET, and Ntrkl-3): negative, The patient receives 4 rounds of chemotherapy with cisplatin, etoposide, ifosfamide, and pegfilgrastim and is sent to the Committee on Thoracic Tumors, where a surgical salvage is determined. A right pneumonectomy is performed through a partial resection of the left atrium without the need for extracorporeal circulation.

During the surgery the left pulmonary artery is dissected and sectioned as well as the main right bronchia. Next the left atrium is partially clamped and is sectioned by TA vascular stapler. The borders of the left atrium are widened confirming the absence of infiltration. The atrium suture is reinforced with Prolene 4/0 and TachoSil® is placed on the suture *(→ Image 1).*

In the post operatory analytic a reduction in the decline of the alpha fetoprotein (AFP) is detected. On the 3rd postoperative day the endothoracic drainage is removed and after discharge from the Thoracic Surgery Service is transferred to the Rehabilitation Service to continue medical care.

Discussion

The endodermal sinus tumor, also known as yolk sac is a type of cancer of the germinal cells that is most frequently found in children. Primary pulmonary yolk sac tumors are extremely rare. There is a general consensus that these tumors occur in the youngest age group, grow very rapidly, are large and necrotic, and are associated with elevated levels of alpha fetoprotein (AFP)[1]. The first case of a pure primary pulmonary endodermal sinus tumor was published in 1993 by Inoue et al.[2] Pelosi et al.[3] published the second case in 2006. The treatment of choice for the yolk sac tumor is neoadjuvant chemotherapy followed by resection of the residual tumor.

BIBLIOGRAPHY

1. DOI: 10.1016/j.jpedsurg.2017.09.020
2. **Inoue H, Iwasaki M, Ogawa J, et al.** Pure yolk-sac tumor of the lung. Thorac Cardiovasc Surg. 1993;41: 249-251.
3. **Pelosi G, Petrella F, Sandri M T, Spaggiari L, Galetta D, Viale G.** A primary pure yolk sac tumor of the lung exhibiting CDX-2 immunoreactivity and increased serum levels of alkaline phosphatase Intestinal isoenzyme. Lnt J Surg Pathol. 2006; 14: 247-25.

4 Subcarinal mass of neuroendocrine origin treated using a robotic approach

Sánchez Valenzuela I, Minasyan A, García Pérez A

Hospital Clínico Universitario de A Coruña

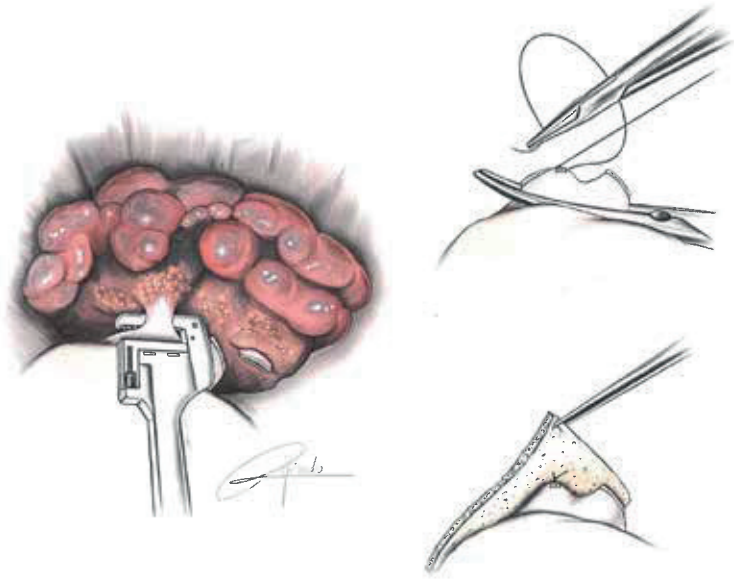


Image 1: Schematic view on the lower right lobectomy with the following closure of the tissue defect using sutures and TachoSil®.

Introduction

Pulmonary neuroendocrine tumors (NETs) are rare and heterogenous entities. They are derived from neuroendocrine cells that exist in many organs and therefore can originate in different parts of the body including the gastro intestinal (GI) tract, lung, thymus and ovary. After the GI tract, the lung is the second most frequent location for the appearance of these tumors – around 25 % of the NETs and 1 – 2 % of lung cancers. The reported incidence of NETs is increasing probably due to improved diagnostic capabilities. The prevalence rates are high given that the patients have prolonged survival.

Pulmonary NETs present diverse pathology and clinical characteristics requiring varied therapeutic strategies. Histologically they are classified in four types: typical carcinoid, atypical carcinoid, large cell neuroendocrine carcinoma and small cell carcinoma.

Although NETs are slow growing tumors, the advanced cases are associated with low survival rates. The localization of the primary tumor has demonstrated to be an important predictor of survival, with the average being 16 months for the metastatic NETs.

The clinical distinction between functional non-functional NETs is important given that the management, approved therapies and treatment paradigms differ between these two types. The NETS that secrete biologically active amines or peptides are call functional and produce varied symptoms such as diarrhea, flushing, abdominal pain, hypotension and vasospasm. Depending on the series, it is estimated that between 10 % and 30 % of the typical and atypical NETs are functional[2,3].

The majority of the NETs express somatostatin receptors (SSTRS)[4], whose presence has important radiological and therapeutic implications. The treatment of the symptoms in patients with functional pulmonary NETs is essential for the management and improvement of the quality of life.

The adequate treatment strategies for the progression of the functional and non-functional tumors are key to prolonging survival. Although these tumors are rare and lack evidence to support optimum treatment strategies, the publication of recent studies that have included patients with pulmonary NETs promote therapies based on evidence for patients affected with this pathology.

Clinical case

Male of 58 years of age, ex-smoker for the last 2 years, accumulated consumption of 40 packs/year, without exposure to other toxins, with a history of 2 months of worsening of his cough with whitish expectoration associated to a weight gain or 21 kg in the last months. Evaluated by his primary care physician with a thorax x-ray in which a nodular prominence in the inferior of the aortic button at the level of the pulmonary aorta window and prominence of the right hilum are observed. A computerized tomography is requested which shows a large mediastinal mass in the subcarinal station of 7 cm at the widest diameter, right hilum adenopathy and bilateral paratracheal, as well as a pleural base pulmonary nodule in the lower left lobe (LLL), of 76 mm.

Afterwards, a PET CT is requested that shows a discrete hypermetabolism at the level of the bilateral hilum (right 2.81, left 3) and subcarinal (2.96). LLL pulmonary node, without clear hypermetabolism. An EBUS is performed with results of subcarinal station and right hilum positive for infiltration by carcinoma with neuroendocrine expression. The Octreoscan showed deposits of the tracer in the subcarinal region and the right pulmonary hilum compatible with lesion with high expression of somatostatin receptors.

With the data obtained a surgical intervention chosen using a robotic approach performing a lower right lobectomy and lymphadenectomy *(→ Image 1)*. Favorable postoperative evolution, with prolonged air leakage that is resolved in a conservative manner and is discharged on the seventh postoperative day.

The pathologic anatomy was compatible with atypical carcinoid tumor in the lower right lobe, affecting the right hilum station and the subcarinal mass also compatible with atypical carcinoid. Discussed in the multidisciplinary committee close follow-up with clinical radiology without adjuvant, given the low proliferation index and R0 surgery.

Discussion

Resection surgery has been the classic treatment of choice in patients with low grade localized neuroendocrine and oligometastatic tumors[5]. Given the advances in thoracic surgery we currently have tools such as the robotic approach with DaVinci that permits the surgeon a three dimensional view, facilitating depth perception and better quality images, as compared to two dimensions with conventional video assisted surgery. This, associated with the great maneuverability of the robotic instruments that are capable of articulating in many directions of flection-extension and rotation that offer wide ranges of movement, as well as the use of gas that facilitates the dissection of the mediastinum. Likewise, the robot reduces human error by reducing trembling and therefore improving precision. All of these benefits of the robotic approach facilitate meticulous dissection and resection surgery in anatomical regions that with other approached would be difficult to achieve.

It is believed that robotic surgery simplifies and facilitates the thoracoscopic approach to pulmonary carcinoid tumors and many other thoracic surgical conditions[6].

The robotic approach is part of the present and the future of thoracic surgery, which is why the specialty is called to accept the challenge of learning and perfecting its use. With greater participation the practice could potentially improve based on the evidence, training, cost-effectiveness and ultimately improve the patients results and their recuperation.

BIBLIOGRAPHY

1. **Yao JC, Hassan M, Phan A, et al.** One hundred years after "carcinoid": epidemiology of and prognostic factors for neuroendocrine tumors in 35,825 cases in the United States. J Clin Oncol 2008;26:3063-72.
2. **Caplin ME, Baudin E, Ferolla P, et al.** on behalf of the enets consensus conference participants. Pulmonary neuroendocrine (carcinoid) tumors: European Neuroendocrine Tumor Society expert consensus and recommendations for best practice for typical and atypical pulmonary carcinoids. Ann Oncol 2015;26:1604-20.
3. **Ferolla P.** Medical treatment of advanced thoracic neuroendocrine tumors. Thorac Surg Clin 2014;24:351-5.
4. **Pasieka JL, McKinnon JG, Kinnear S, et al.** Symposium on the treatment methods of carcinoid syndrome for gastrointestinal carcinoid tumors: summary of the symposium. Can J Surg 2001;44:25-32.
5. **Tan GJ, Poon JS, Khoo PL, et al.** Robotic removal carcinoid tumor. Asvide 2018;5:424. Available online: http://www.asvide.com/article/view/24424
6. **Cerfolio R, Louie BE, Farivar AS, et al.** Consensus statement on definitions and nomenclature for robotic thoracic surgery. J Thorac Cardiovasc Surg 2017;154:1065-9.

5

Usage of TachoSil® as a sealant over the resection of an esophageal duplication cyst; an infrequent finding in the mediastinum

Fernández González OA, Moreno Merino SB, Gañán Boscá A, Zúñiga Sánchez LG, García Bautista C

Hospital Regional Universitario de Málaga

Introduction

Duplication cysts are congenital malformations that are produced during the embryological development. Simple cysts are epithelia duplications, while the true esophageal duplications are duplications of the submucous and the muscular wall. Suspicion begins after incidental radiological findings and that are generally asymptomatic, and in the case that symptoms appears, they produce dysphagia, epigastric pain, retrosternal pain or respiratory symptoms. Here we present the case of an esophageal duplication cyst removed by right video thoracoscopy, we comment on some details of the intervention using an adhesive collagen matrix coated with fibrinogen and thrombin to seal the esophageal wall where the cyst was located.

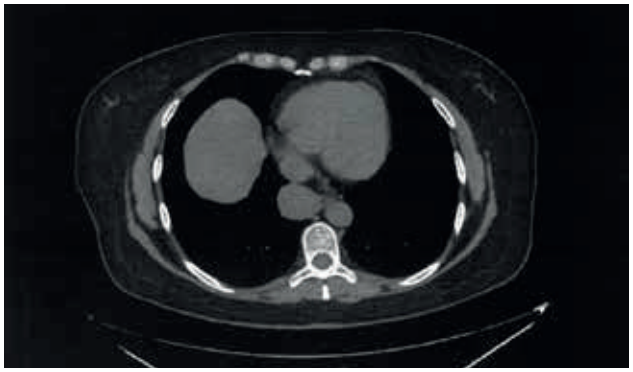


Image 1: Thorax CT in axial slice. Round lesion in the posterior mediastinum in wide contact with the esophagus.

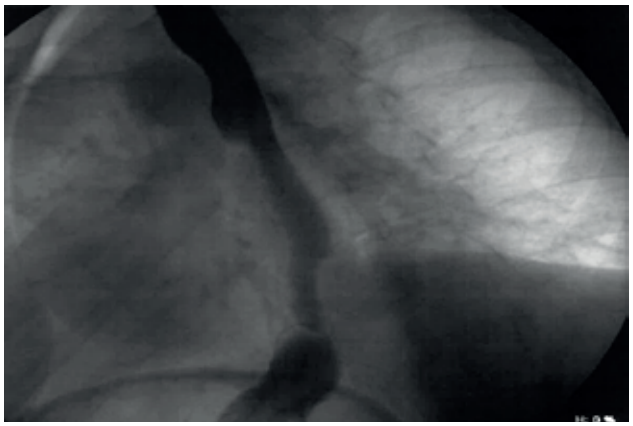
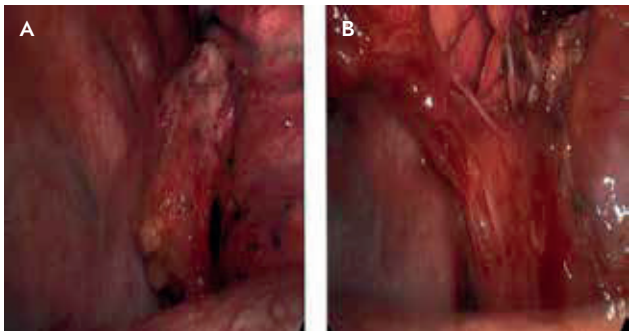


Image 2: Barium esophago-gastric transit with imprint on esophageal terciodistal, conditioning partial stenosis of the esophageal lumen.



Images 3A: Lesion in the posterior mediastinum. **3B:** Dependent pedicle of distal esophagus.

Image 4: Sealant over esophagus surface.

Clinical case

A female of 63 years old without medical history of interest, with clinical nonspecific thoracic pain and dyspnea on exertion with 6 months of evolution that after symptomatic treatment with analgesics due to the persistence of the clinical condition, a radiography of the thorax was performed that showed an increase in the radiologic density surrounding the right paracardic. In the computerized tomography (CT) *(→ Image 1)* of the thorax this finding corresponds to a cystic lesion in the posterior mediastinum of 45 mm in diameter, with broad contact with the third distal of the esophagus *(→ Images 3A and 3B)*.

In the barium transit an extrinsic impression can be seen over the posterior wall of the third distal of the esophagus *(→ Image 2)*. With these findings in the image study, the patient was evaluated in consultation with Thoracic Surgery where it was decided to perform surgery with diagnostic-therapeutic intent.

Under general anesthesia and selective pulmonary intubation a an exploratory right bi-portal video thoracoscopy was performed, observing a cyst-like lump in intimate contact with the right inferior lobar vein and the distal esophagus. Faced with these findings the esophagus was tutored with a nasal gastric tube and the dissection of the cyst was performed, initially without aspirating its content to facilitate the dissection which was carried out with scissors and an ultrasonic scalpel. After dissecting it from the esophageal mucosa for complete exeresis, the procedure continued to prove the integrity of the esophageal mucosa initially, covering it with saline and injecting aire through the nasal gastric tube, afterward with methylene blue solution without observing extravasation from the esophagus. In spite of the absence of leakage, the esophageal mucosa seal was reinforced using an adhesive collagen matrix, coated with fibrinogen and thrombin (TachoSil®) *(→ Image 4)*, leaving a 24F silicone endothoracic drainage tube.

The final anatomopathological study revealed an esophageal duplication cyst. The patient evolved favorably during the post operative period being discharged 2 days after the intervention. After 3 months of follow-up, the patient remained asymptomatic.

Discussion

The esophageal duplication cyst (EDC) is a rare congenital anomaly, in the context of masses developed in the mediastinum, due to the incomplete vacuolization process of the esophagus. The EDC can be unique anomalies or associate to other malformations of the gastrointestinal, bronchopulmonary or vertebral tract. It constitutes 3 % of the mediastinum tumors, with a higher frequency of appearance in the masculine sex and up to 60 % of localization in the distal esophagus.

Although the majority of patients are asymptomatic, they may appear due to clinical compression over neighboring structures causing dysphagia, cough, or thoracic pain as in the case of our patient.

The diagnosis of the esophageal duplication cyst tends to be incidental, after a simple x-ray of the thorax, where a round and delimited mediastinal lesion can be observed. The most frequently used complementary explorations that help with the clinical diagnosis are the CT and magnetic resonance (MR). The ultrasound endoscopy is a diagnostic tool of great utility since it allows to specify the anatomical relationships of the cyst with the esophagus, being considered the proof of choice. Nonetheless, the definitive diagnosis can only be established after its removal and anatomopathological study.

In the case of asymptomatic patients, the conservative treatment seems to be a reasonable measure, however, the treatment of choice is the surgical removal due to the possibility of development of compressive phenomena and their possible complications. In general, a thoracic approach is performed, such as thoracotomy or minimal invasive surgery, with video thoracoscopy being the technique of choice due to the advantages associated with this type of approach, less postoperative pain and a shorter hospital stay.

BIBLIOGRAPHY

1. **Zúñiga S, Skorin I, Gejman R.** Esophageal duplication. Rev Chilena de Cirugía. 2010 Ago. 62 (4):395-398. doi: 10.4067/S0718-4026201.0000400013.
2. **Rico-Morales MM, Ferrer-Márquez M, Belda-Lozano R, Yagüe-Martín E, Felices-Montes M, Rubio-Gil F.** [Esophageal duplication cyst as an unusual cause of adult dysphagia]. Cir Esp. 2007 Dec;82(6):361-3. Spanish. doi: 10.1016/s0009-739x(07)71748-7. PMID: 18053507.
3. **Fibla JJ, Penagos JC, Farina C, Gómez G, Estrada G, León C.** Esophageal duplication cyst. Cirugía Española. Vol 75, num 6. 359-361. 2004. doi: 10.1016/80009-739X(04)72339-8.
4. **Izaskun Markinez Gordobil, Jose Luis Elorza, Santiago Larburu, Jose Ignacio Asensio.** Esophageal duplication cyst removal using thoracoscopy. Cirugía Española, Volume 89, Issue 6,2011, 408410.https://doi.org/10.1016/j.ciresp.2010.06.011.
5. **Angulo-Molina D, Salceda-Otero JC, Lozoya-González D, Farca-Belsaguy A.** [Esophageal duplication cyst: an unusual finding]. Rev Gastroenterol Mex. 2012 Jul-Sep;77(3):141-2. Spanish. doi: 10.1016/j.rgrnx.2012.04.006. Epub 2012 Aug 21. PMID: 22921103.

6

Surgical rescue of cervical-mediastinal teratoma

Pérez Pérez S, Victorero Fernández R, Rodríguez Torres L, Gallegos Esquive E, Huerta Martínez L, Simón Adiego C

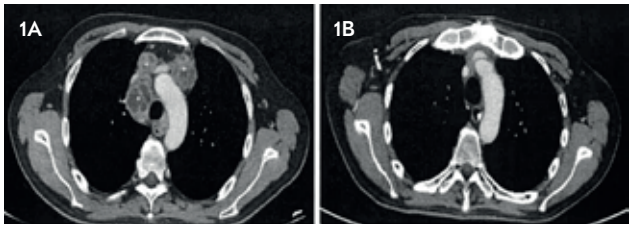
Hospital General Universitario Gregario Marañón, Madrid

Introduction

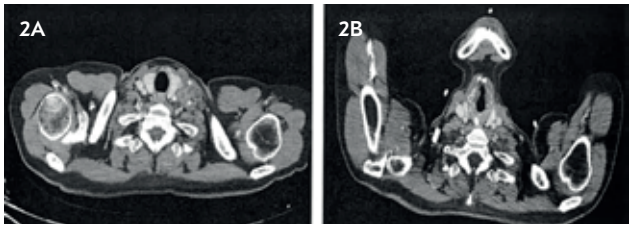
Testicular cancer is an infrequent illness with a good prognosis, in Europe achieving cure in up to 97 % in all stages[1]. The therapeutic regimens of choice for the metastasis in this type of cancer include orchiectomy, chemotherapy schemes based on cisplatin and the resection of the residual tumor[1,2].

In general, a diminishing of the tumoral markings occurs after the chemotherapy, reducing the metastasis to residual tumors. However, an infrequent complication exists that may occur in patients with non-seminomatous germ cell lineage tumors (NSGCT) denominated as Syndrome of the "growing teratoma"[3], defined as a normalization of the serological tumor markers, and a growing tumor mass compatible with mature teratoma[4]. The prevalence of this condition, in metastasis illness in NSGCT, varies between 1.9 % – 7.6 %.

A case is presented of a patient diagnosed with a testicular tumor of mixed germ of a non-seminomatous strain, that appears after chemotherapy treatment, persistence of bulky abdominal and cervicomediastinal lesions. The clinical case and the thoracic surgical procedure which required a broad approach by cervical sternotomy, are described.



Images 1A: Shows axial slice of computerized tomography (CT) at mediastinal (aortic arch) after second dose of TIP (Taxol, Ifosfamide, Cisplatin). The white asterisks (•) mark the mediastinal lesions. **1B:** Shows the axial slice at the same anatomical level as in Image A corresponding to the control CT after 1.5 months of the cervical mediastinal surgical rescue, observing compete resection of the previously described lesions.



Images 2A: Shows axial slice of computerized tomography (CT) at the cervical level after second dose of TIP. The white asterisks(*) mark the cervical lesions. **2B:** Shows the axial slice at the same anatomical level as in Image A corresponding to the control CT after 1.5 months of the cervical mediastinal surgical rescue, observing compete resection of the previously described lesions.

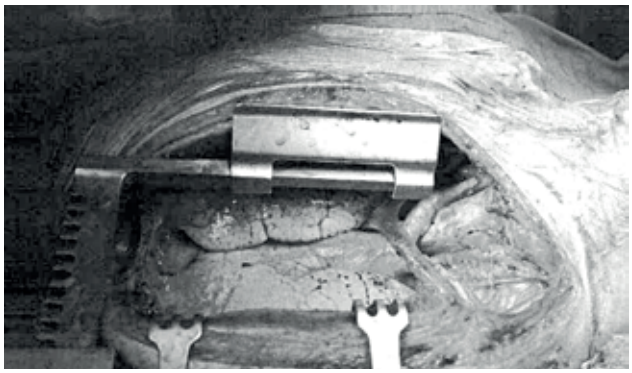


Image 3: Approach for cervico-sternotomy. The right part of the image corresponds to the patient's head. View of the surgical field after the resection of the cervical mediastinal masses, with exposure of the cervical vessels. The left innominate vein (LIV) and the bifurcation of the left common carotid artery ICCA/I are almost completely visualized.

Clinical case

Male of 41 years of age, that debuts with a painful stone mass at the level of the right testicle. The diagnosis using computerized tomography (CT) of the right testicular mass associated with bulky mediastinal, retroperitoneal and right iliac adenopathies. The study of serological tumor markers reveal a significant elevation of alpha fetoprotein (AFP) and the human chorionic gonadotropin (HCG).

After three months of the initial diagnosis, the patient has a radical right orchitectomy, with anatomical pathology of mixed germinal non-seminomatous tumor class IIIB (teratoma with immature tissue components 60 %, embryonic carcinoma 30 % and endodermal sinus tumor 10 %)

Adjuvant chemotherapy is associated with BEP (Bleomycin, Etoposide, Cisplatin), with normalization of tumor markers after the third round.

Prior to submitting to a fourth round of BEP, there is an appearance of a left supraclavicular adenopathy. A control CT is performed observing a significant increase of the left supraclavicular adenopathy and multiple conglomerates of right mediastinal, retroperitoneal and iliac chain adenopathies, of which various have increased in size. The result of the supraclavicular adenopathy biopsy is mature teratoma.

After a fourth round of BEP, a significant rise of the AFP, previously normalized, is observed.

Prior to the elevation of MT, it is decided to initiate a second line of chemotherapy treatment with the TIP scheme. Upon completion of chemotherapy treatment, in the multidisciplinary tumor committee it is decided to perform a surgical rescue of the residual lesions in two steps.

Pre-surgical re-evaluation of the CT *(→ Images 1 and 2):* necrotic adenopathies with a tendency to confluence, forming adenopathic conglomerates in left supraclavicular territories, upper para tracheal, prevascular and with similar characteristic to those described in the retroperitoneal area extending to the right external iliac area.

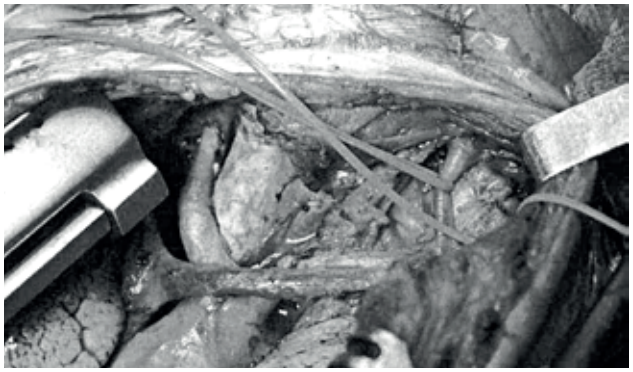


Image 4: Visualizes the path of the left innominate vein (LIV) after bifurcation from the superior vena cava (SVC). Separated by vessel-loop, the left internal jugular vein (LIJV) is visualized.

Image 5: Application of fibrin sealant patches (TachoSil®) over the area of the laryngo-trocheal region.

Image 6: Application of TachoSil® fibrin sealant patches over the medullary bone borders of the sternum toblas, prior to closing the middle sternatomy.

At four months after the last round of TIP, the patient is subjected to abdominal surgical time. A retroperitoneal cytoreduction is performed. The anatomopathological result of the totality of the resected masses is mature teratoma. The serological tumor markers are normalized in the postoperative period.

Three months later the patient is intervened to resect the cervical-thoracic lesions.

Through a cervical-median sternotomy on the anterior border of the left sternocleidomastoid, the cervical region is accessed, supraclavicular bilateral and mediastinal, which permits a favorable exposure to the cervical neuro-vascular structures, subclavian vessels and brachial plexus *(→ Image 3)*.

The multiple cervicomediastinal tumors are resected that include the left supraclavicular fossa *(→ Image 4)*, left paratracheal (that occupies all of the space up to the bifurcation of the left bronchia), right paratracheal, as well as the anterior mediastinum.

The tumor engulfs the innominate vein and displaces anterolaterally the superior vena cava and the azygous vein, progressing up to the left pre-vascular zone and laterally surpassing the left phrenic nerve, obligating the sectioning of the azygous vein and dissecting and broadly movilizing the phrenic and vagus nerves.

Completing the resection of the tumor lesions, hemostasis is performed in the bleeding zones through electrocoagulation and application of fibrin sealant patches (TachoSil®) over the area of the tracheal ring *(→ Image 5)* and medullary borders of the mid sternotomy *(→ Image 6)*. The pathological anatomy result of all of the resected cervical-mediastinal tumors was mature teratoma, without observing in any of the samples, histological signs of epithelial nor mesenchymal malignancy.

The patient has a positive immediate postoperative evolution, with aphonia and transient pharyngo-laryngeal dysphagia, as the only notable complication.

A month after the intervention a control CT is performed, demonstrating the complete resection of the cervical mediastinal lesions described in the pre-operative images *(→ Images 1B and 2B)*.

Discussion

In 1982, Logothesis et al, describe for the first time the syndrome of the "growing teratoma" (GTS), as a phenomena of a growing tumor, followed by the normalization of tumor markers after or during systematic chemotherapy treatment[3].

The mechanism which causes GTS, continues to be unclear. Hiester, et al. proposed the hypothesis that the embryonic carcinoma cells, can differentiate themselves in transit amplifying cells (TAC) under chemotherapy treatment. These cells can auto-renew themselves or differentiate themselves even more in three layer germinal cells, promoting the growth of the teratoma. These cells are denominated TF-TAC (Teratoma Forming — Transit Amplifying Cells)[5].

The GTS is an infrequent phenomenon, with an incidence in metastasis illness in NSGCT, that varies between 1.9 % — 7.6 %. Around 90 % of the cases, present retroperitoneal localization, but in addition to this location we can find it in the thorax in the form of thoracic growing teratoma (TGTS) simple, or in multiple localizations, surrounding neighboring structures.

Given the chemo/radio refractory condition of this illness, surgery is considered the treatment of choice, and its complete resection not only reduces the range of recurrence, but also prevents somatic malignancy of the residual lesions.

The global rate of survival of 5 years described in the literature in patients with GST, oscillates around 90 %[6]. Likewise, recurrence in those patients that undergo a complete resection, is in the range of 0 — 4 %, while among those with partial resection it ascends to 72 — 83 %.

These cases, can require high complexity surgeries in various steps.

Given the technical challenge that the medical and surgical treatment implies for these patients, they must be performed in centers of reference with specialized multidisciplinary teams.

In this case, the first step selected was abdominal, achieving a complete resection with pathological anatomy result of mature teratoma of all of the resected lesions.

Malignancy is discarded, despite the complex location of the cervical and mediastinal tumors, the patient was intervened jointly by Thoracic Surgery and Cardiovascular Surgery. The procedure is performed through cervico-sternotomy and with the provision of extra corporeal circulation, that finally was not necessary.

This approach permitted a good exposure of the anatomical structures and a complete resection of the lesions. The ample surgical manipulation, is not free of complications, highlighting the risk of intra and post operative hemorrhaging. In zones where it is preferable to avoid electrocoagulation, such as the laryngeal-tracheal, or in those that electrocoagulation is not very effective, such as the medullar surfaces, fibrin patches, in our experience, are an efficient resource. In the case of sternotomy, the posterior reabsorption of the fibrin patch will prevent the problems associated with foreign bodies as in the case of wax seals[7].

In conclusion, the complex case of "growing teratoma" has been presented, which shows abdominal, cervical and mediastinal tumors. The therapeutic scheme described, with aggressive sequential surgical procedures, performed by carious specialized teams, has permitted the complete resections of the lesions with low morbidity and a post operative life of good quality.

BIBLIOGRAPHY

1. **Albers P, Albrecht W, Algaba F, Bokemeyer C, Cohn-Cedermark G, Fizazi K, Horwich A, Laguna MP, Nicolai N, Oldenburg J.** European Association of Urology. Guidelines on Testicular Cancer: 2015 Update. Eur Urol. 2015 Dec; 68(6):1054-68.
2. **Sponholz S, Chalepaki Ntelli K, Karaindros G, Schirren M, Lorch A, Hiester A, Albers P, Schirren J.** Short-term and long-term outcomes after resection of thoracic growing teratoma syndrome. World J Urol. 2021Jul;39(7):2579-85.
3. **Logothetis CJ, Samuels ML, Trindade A, Johnson DE.** The growing teratoma syndrome. Cancer. 1982 Oct; 15;50(8) :1629-35.
4. **Tanaka K, Toyokawa G, Tagawa T, Ijichi K, Haratake N, Hirai F, Oda Y, Maehara Y.** Successful Treatment of Growing Teratoma Syndrome of the Lung by Surgical Resection: A Case Report and Literature Review. Anticancer Res. 2018 May; 38(5):3115-18.
5. **S. Hiester A, Nettersheim D, Nini A, Lusch A, Albers P.** Management, Treatment, and Molecular Background of the Growing Teratoma Syndrome. Urol Clin North Am. 2019 Aug; 46(3):419-27.
6. **Maroto P, Tabernero JM, Villavicencio H, Mesía R, Marcuello E, Solé-Balcells FJ, Sola C, Mora J, Algaba F, Pérez C, León X, López López JJ.** Growing teratoma syndrome: experience of a single institution. Eur Urol. 1997; 32(3):305-9.
7. **Robicsek F, Masters TN, Littman L, Born GV.** The embolization of bone wax from sternotomy incisions. Ann Thorac Surg. 1981 Apr; 31(4):357-9.

7

Resection of lower left lobe squamous carcinoma (ct4N0M0) with infiltration of the left atrium, descending aorta and diaphragm ("T4 multiple")

Rombolá Carlos A, Libreros Niño EA, Torreguitart Mirada N, Zuil Moreno M, Sampedro Salinas CA, Montesinos Encalda ME

Hospital Universitario Arnau de Vilanova, Lleida

Introduction

Resection surgery is an important component in the multidisciplinary treatment of advanced localized lung cancer. Non-small cell lung cancer (NSCLC) is a neoplasm with high mortality, particularly when it is diagnosed in advanced stages[1].

In the eight edition of the TNM a group of heterogeneous tumors that comply with at least one of these descriptions: tumors larger than 7 cm o that invade the mediastinum, heart, large vessels, trachea, recurrent larynx nerve, vertebral bodies, esophagus, carina, nodes in different ipsilateral lobes and infiltration of the diaphragm were defined as T4. In the seventh edition, the latter, became considered T3 to T4. However, clear evidence does not exist of the sum of various of these descriptors may have on the prognostic impact of the same patient. In this group it is essential to carry out a correct selection of the patients[1].

On the other hand, the complete resection of the T4 tumors, tends to require meticulous pre-surgical planning, that covers multiple aspects related to the surgical technique under consideration, and with the morbimortality. This is generally multi-disciplinary, the same as in the case of the involvement of the aortic wall.

The objective of this work is to comment on a clinical of resection of a pulmonary tumor that complies with multiple T4 descriptors, among them the size, the apparent affectation of the left atrium, of the aorta, the diaphragm and the mediastinum.

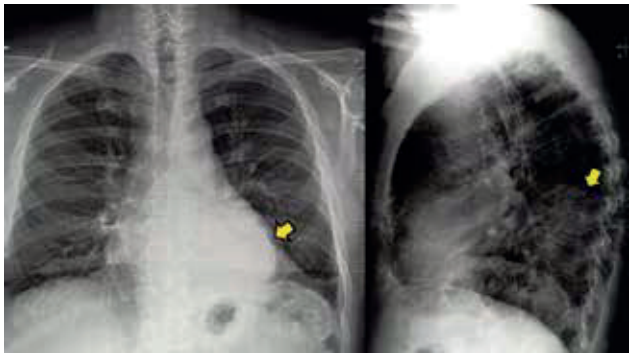
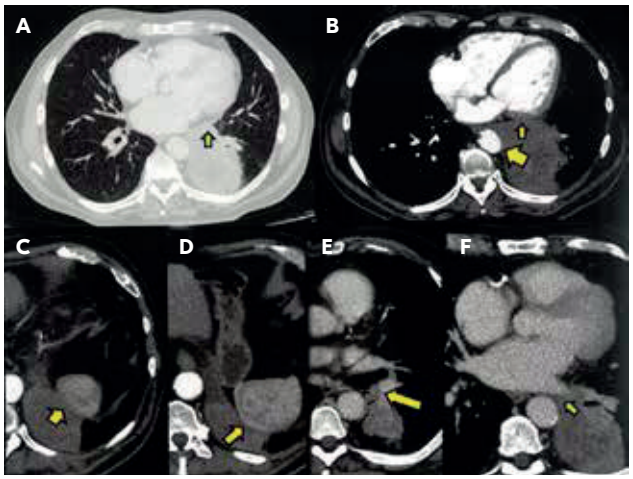


Image 1: Preoperative chest radiologic pair. The presence of a retrocardiac mass in the left inferior lobe can be observed, which is marked with arrows.



Images 2: Computerized tomography of the thoracic-abdominal. **A:** In the parenchyma window, a heterogenous mass on the left lower lobe (95 x 92 x 70 mm) can be seen that occupies almost the entire LLL, apparently associated to a transcisural infiltration or an adjacent adenopathic interlobar conglomerate, next to the pedicle of the lingula (marked with an arrow). **B:** In the mediastinal window, arrows identify the probable pericardial and left ventricular infiltration and the descending aorta without a fatty separation plane. The deformity of the contour of the aorta is also observed at this level, which occupies a large part of its circumference. **C and D:** With the arrows signs of possible diaphragmic infiltration are highlighted. **E:** The mass that extends into the proximity of the pedicle of the lingula is marked. **F:** Marks the infiltration of the pericardium and the lower left pulmonary vein in the mouth of the left atrium, principally in its posterior recess.

Clinical case

The case is of an overweight (BMI 29 kg/m²) 67 year old male with pathology history of type 2 diabetes mellites who presents with toxic syndrome (asthenia, anorexia and weight loss of 16 kg) of 6 months of evolution, associated with hemoptotic sputum. It is worth mentioning that he had been a smoker of 2 packs/day until 17 years ago, when he suffered an antero-posterior infarction with single-vessel disease treated with 3 coronary stents.

In the radiologic pair of thorax, a retrocardiac mass can be in seen in the lower left lobe (LLL) that is confirmed with a thoracic abdominal CT showing a heterogenous tumor of approximately 95 mm almost completely covering the LLL, contacting the parietal posterior and basal pleura, the diaphragm and the descending aorta without a fatty separation plane. It also has ample contact with the left cardiac cavities with a focal loss of the separation plane. In addition, there is an interlobular adenopathy conglomerate at the lingual pedicle *(→ Images 1 and 2)*.

The extended studies of a cranial CT (no evidence of cerebral metastasis) and PET-CT. This describes hyper metabolism at the tumor level (SUV max 10.6), that reaches the origin of the left superior bronchial lobar There are no detectable hyilomediastinal adenopathies suggestive of malignancy, only bilateral paratracheal adenopathies of scarce dimensions of 14 mm with SUV max 1.8. Findings compatible with pulmonary neoplasia T4N0-2MO *(→ Image 3)*.

The thick needle biopsy results positive for non-small cell cancer (squamous cell cancer). The patient is presented in the Thoracic Tumors Committee (TTC) for a multidisciplinary approach, where surgical treatment is not discarded.

An eco-endoscopic evaluation (EBUS) is performed that reveals mucous infiltration in the LLL with negative adenopathy biopsies (4R, 7 and 4L). The lymph node staging is completed with mediastinoscopy that confirms the negative results in the lymph nodes of the lower and upper paratracheal, left paratracheal, subcarinal and right hilum (cT4NOMO).

The MRI reports signs of infiltration in the pericardium, lower left pulmonary vein through the left atrium outflow, left posterior hemidiaphragm (extension of approximately 2.5 cm) and aortic mural wall (extension length of approximately 4.5 cm).

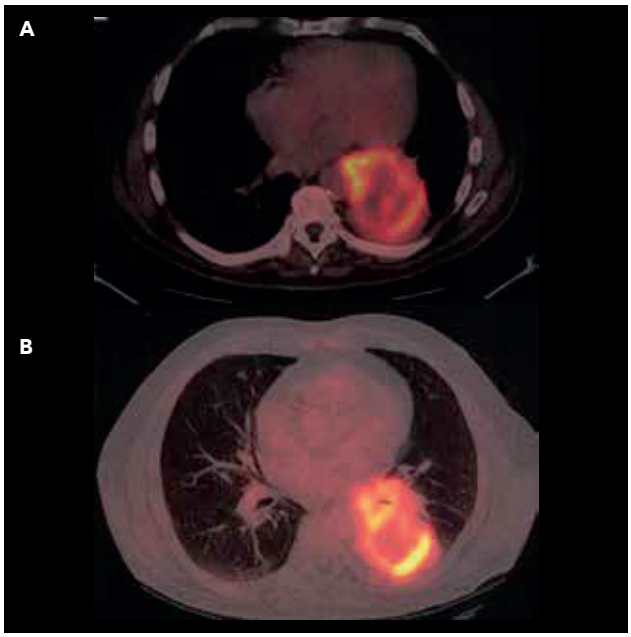
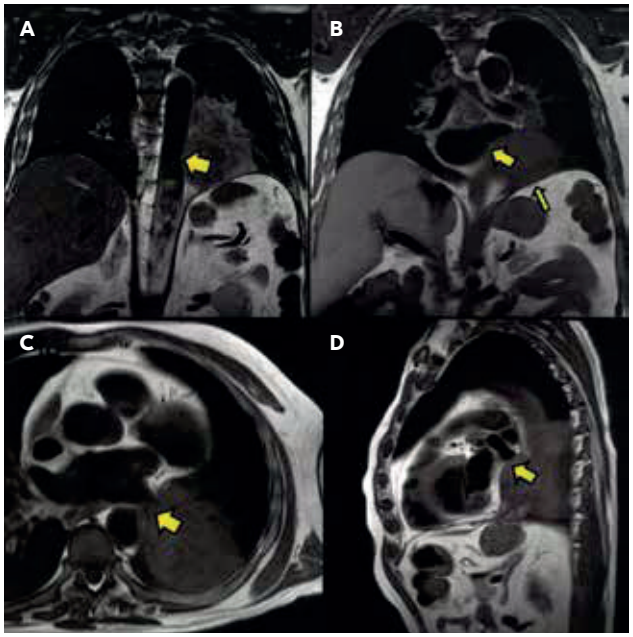


Image 3: Pre-operative PET-CT scan. **A and B:** A hypermetabolic mass is described (SUV max 10.6) in the IU that engulfs the left inferior bronchial lobe and the origin of the upper left lobe, makes contact without being able to determine the infiltration of the parietal pleura, the diaphragm, the 1st descending aorta, the inferior pulmonary vein and the left cardiac structures. At the hilar level, appears to perforate the fissure and invade basal segments of the LUL.



Images 4: Magnetic Resonance Imaging. **A:** Voluminous tumor in LLL of 9.6 x 6.8 x 8.8 cm (CC x LL x AP) that medially contacts broadly with the aorta in approximately half of its circumference, with discreet rectification of the wall suggestive of aortic mural infiltration, with longitudinal extension of about 4.5 cm. Could infiltrate the left posterior hemidiaphragm with an extension of approximately 2.5 cm. Does not appear to infiltrate the esophagus. **B and C:** In its inferomedial portion, the mass infiltrates the lower left pulmonary vein from its outlet to the LA occluding it. **D:** Probably previously affects the pericardium adjacent to the inferolateral basal segment of the IV. Fatty interface between the myocardium and the tumor is identified, with no evidence of local myocardial infiltration.

It doesn't appear to infiltrate the left ventricle or the esophagus (→ *Image 4).*

The functional respiratory tests results: FVC 3.34 (73 %), FEV1: 2.57 (76 %) y DLCO 67 %. The aforementioned post operative values for left pneumonectomy, evaluated using perfusion Gammagraphy (left lung of 37 %), are: epoFEV1: 48 % (1'62 L) y epoDLCO: 42 % (11.64 mL/mmHg/Mi). The ergometry concludes marking a moderate surgical risk for left pneumonectomy (V02: 16.5 ml/kg/min)

After re-evaluation by TTC, a surgical resection is determined and neoadjuvant treatment is discarded by the surgeon to avoid a probable increase in the adherences at the aortic level.

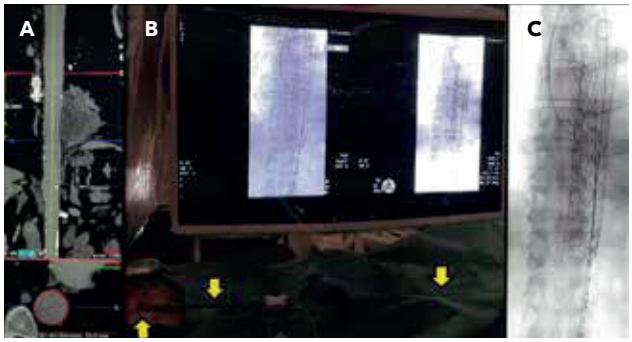
Two days prior to the resection, an endovascular aorta thoracic prothesis (TAG Gore Conformable 34 x 34 x 150) is inserted through the right femoral artery *(→ Image 5)*, without incidences during nor postoperative, being closely monitored by the neurologists and intensive care staff in the Intensive Care Unit to discard signs of medullary ischemia until the time of the pulmonary resection surgery.

After selective intubation and placement in left lateral decubitus, an approach is performed via left anterolateral thoracotomy with muscular preservation and video thoracoscopy assistance to improve the visualization of almost all of the intrathoracic maneuvers carried out (→ *Image 6).*

A left inferior intrapericardial lobectomy is performed including cuff lingulectomy with bronchoplasty; resection of the pericardium, section of the left inferior pulmonary vein with margin of left atrium, partial resection of diaphragm, partial resection of the descending aortic wall reconstruction of the diaphragm and pericardium with prosthetic meshes and systematic lymphadenectomy.

Description of the technique

After removing the pulmonary adhesions, a mass of approximately 11 cm is observed that occupies all of the LLL, adhered to the diaphragm and mediastinum, with apparent transcisural filtration at the hilar level. The LLL of the diaphragm is released from the diaphragm, resecting a diaphragmatic "medallion" of approximately 7 cm in diameter, with preserved macroscopic margins.



Images 5: Placement of thoracic aorta endoprosthesis. **A:** Image of the virtual planning with the corresponding measurements at the proximal and distal extremes of the aortic tumor infiltration, placing the endoprosthesis with 5 cm of proximal margin (reaching 3 cm at the outlet of the left subclavian artery) and 3 centimeters towards the distal (reaching 4 cm above the celiac trunk). **B and C:** Arrows mark the right femoral access, the introducer and the guide wire. On the screen, the dilatation of the endoprosthesis (TAG Gore conformable 34 x 34 x 150) can be observed with the guide still in place.

Image 6: Placement in right lateral decubitus. Preparation for the left anterolateral thoracotomy approach with muscular preservation and video thoracoscopy assistance.

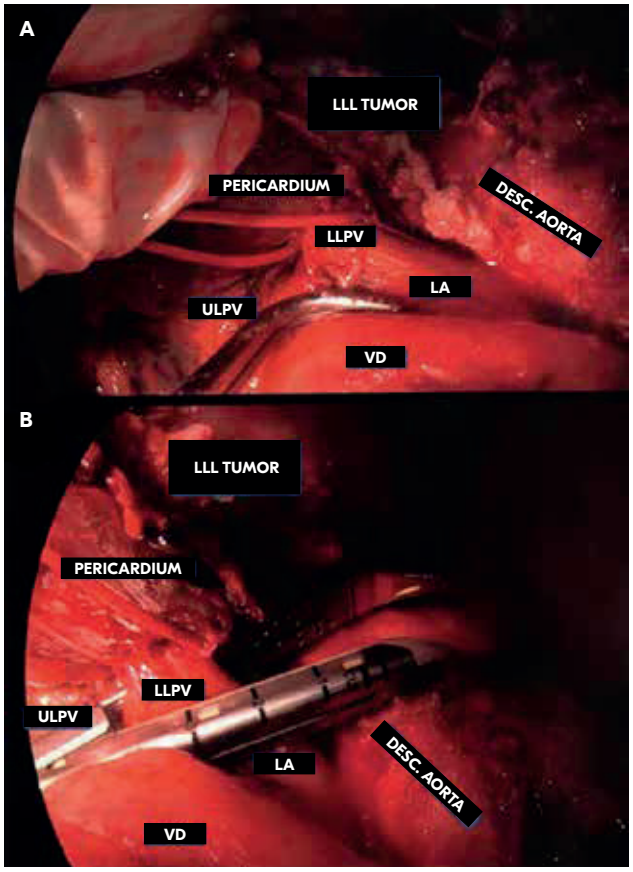
The reconstruction is performed with an expanded polytetrafluoroethylene mesh of 1 mm that is attached with a discontinuous silk suture 1. Continuing with the wide opening of the pericardium and exploration discarding infiltration of the left ventricle. After placement of traction sutures, infiltration of the pericardium and the left inferior pulmonary vein at the level of the outlet of the left atrium is confirmed; as well as the adjacent epicardial fat, being able to prove the absence of affectation of the left upper pulmonary vein *(→ Image 7)*.

Dissection of the pulmonary pedicle and lymphadenectomy of the aortic and hilar window groups, which are reported as negative on interoperative pathology, are continued.

Once the resectability is proven and after the opening of the intravenous pericardium recesses, the proximal section of the left inferior pulmonary vein at the level of the left atrium is performed with vascular endografting, the posterior pericardium is sectioned and the adherences of the esophagus are removed with cleavage plane. At the interlobular hilum a probable complex adenopathy or tissue suggestive of neoplasia is identified adjacent to the pedicle of the lingula, which leads to a cuff lingulectomy with anastomosis T-T of the bronchus of the culmen with the left principal bronchus with a continuous polypropylene 4 — 0 suture and separated reinforcement sutures *(→ Image 8)*.

During these maneuvers, the tumor of the aortic wall comes off, leaving a medallion of tumorous tissue of approximately 5 cm adhered to it. After the ectomy of the surgical piece (left inferior lobectomy and cuff lingulectomy) all of the neoplastic tissue adhered to the descending aorta, along with the adventitia of the same, is resected, finding a cleavage plane suitable for the complete macroscopic resection. In the bed there are areas of exposure of the aortic intima, making it unnecessary to leave the endoprosthesis exposed. The oncological margins are informed as free of the disease in the interoperative pathologic anatomy *(→ Image 9)*.

The pericardial opening is partially closed with a 910 polyglactin mesh and a hemostatic reinforcement is placed over the middle and intima layers of the aorta with a medicated matrix that is also used to seal air leaks in the culmen parenchyma *(→ Image 10)*.



Images 7: Intrapericardial view. **A:** Interoperative view of the left atrium (LA) and of the lower left pulmonary vein (LLPV) from the front, infiltrated by the tumor of the LLL up to the mouth of the atrium. At this level the reference with a "vessel loop" can be observed. The internal face of the pericardium adhered en bloc to the tumor and to the LLL is pulled toward the "zenith". The tumor's infiltration at the level of the descending aorta can be observed and the clear indemnity of the upper left pulmonary vein (ULPV) after the section of intrapericardial recesses and their dissection. VD: ventricles. **B:** Same image with the vascular endografting ready for the section at the level of the left atrium guaranteeing the margin of the resection.

After checking the pulmonary re-expansion and absence of air leakage, the intercostal nerves are infiltrated, pleural drainages are placed and the closure of the thoracotomy is performed according to practice.

The postoperative in intensive care transpires without incidence, hemodynamically stable, no neurological alterations and no signs of secondary spinal cord ischemia to devascularization of the Adamkiewicz artery.

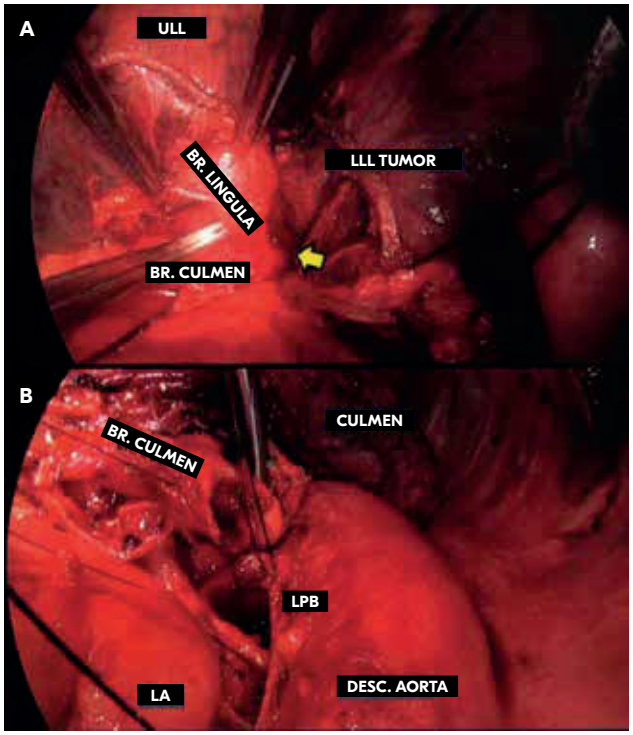
After 48 hours, is moved to the Thoracic Surgical floor, with correct pain control with the prescribed analgesic. The pleural drains are removed on the fourth post operative day and on the seventh day hospital discharge is indicated, prior control of the anastomosis by fibro bronchoscopy *(→ Image 11)*.

The definitive result of the pathological anatomy reports a squamous cell carcinoma of 11 centimeters, pT4 NO MX (STAGE IIIA) with doubtful R1 at the level of the aortic adventitia, with the presence of minimum outbreaks of squamous cell carcinoma affecting the deep side of the adventitia (surface painted with Indian ink). Without tumoral affectation of the diaphragm nor of the lingula, that presented nonspecific inflamed tissue.

In the tumor committee, adjuvant radiotherapy was discarded, the patient being a candidate for adjuvant chemotherapy.

In the ambulatory check-ups, the patient did not present clinical or radiological incidences, where the pulmonary re-expansion was proved and the correct placement of the aortic endoprosthesis showed absence of dyspnea and slight pain, requiring occasional analgesics *(→ Image 12)*.

Continues with chemotherapy treatment and antiplatelet agents in the 3 month postoperative check up.



Images 8: Bronchoplasty. **A:** The arrow indicates the apparent tumor or inflammatory infiltration adjacent to the bronchus (BR. LINGULA) and arteries of the lingula, with probable transcisural infiltration at this level and close to the culmen bronchus (BR.CULMEN). **B:** After performing the lobectomy of the LLL and a resection in the cuff of the lingula, assuring margins free of malignancy in the intraoperative pathologic anatomy, the anastomosis between the culmen bronchus and the left main bronchus is performed. The difference of the calibers between both ends of the anastomosis can be observed.

Discussion

The optimum treatment option of NSCLC in stage T4 N0/1 MO is still under debate[1]. Some authors, consider the surgical resection of the T4 as the best option, whenever it is completely resectable and is not associated with associated mediastinal adenopathies. A 4 % postoperative mortality rate and a morbidity index of 35 % is described for this group of patients operated in centers with vast experience. Although the group of T4 is somewhat heterogenous, a survival rate of 5 years is calculated for 43 % of those with compete resection, and falls significantly if it coexists with ganglion metastasis[2].

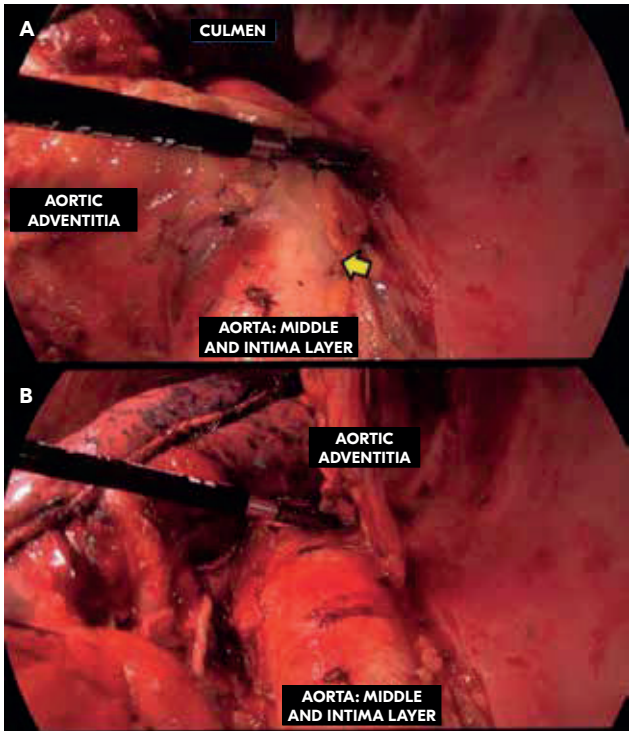
According to the current National Comprehensive Cancer Network (NCCN) guides and the American College of chest Physicians, surgery is the pilar of treatment for resectable T4 N0/1 MO patients[3].

Neoadjuvant chemoradiation therapy is considered the other treatment option for those patients with tumors that are considered principally resectable, while definitive concomitant chemoradiation therapy is recommended for those which are not resectable[1-4].

However, in some cases the neoadjuvant could be associated to an increase in the morbimortality, principally in the case of a possibility that a pneumonectomy is indicated. In our case, we have also preferred to disregard this to avoid possible adherences to the aorta that lead to a greater resection of the wall.

The therapeutic approach for patients in advanced stages of NSCLC is controversial, particularly the surgical management of a subset of T4 tumors that infiltrate the heart, the large vessels and other structures of mediastinum[5].

However, the advances in imaging techniques such as computerized tomography, sonograms and magnetic resonance, have improved the preoperatory evaluation of signs the suggest dissemination and/or infiltration[5,6]. In spite of these advances, the absence of the fatty plane or the separation of the tumor and the adjacent structures, confirmation of infiltration could not be categorically confirmed. In our case, for example, the pathological anatomy result definitively discarded the suspicion of clinical and interoperative diaphragmatic infiltration.



Images 9: Resection of aortic adventitia. **A:** Inferior view of the descending aorta being able to observe the approximately 5 cm medallion of tumor tissue that infiltrates the adventitia, pulling forward and upward, exposing the cleavage plane. The arrow marks some of the areas of the aorta with exposure of the intima layer. **B:** Pulled toward the "zenith" of the aortic adventitia tissue infiltrated during its resection. The healthy aspect of the exposed media and intima layers of the aorta can be observed. Above and anterior to the bipolar energy instrument, the culmen with the stapling line is observed.

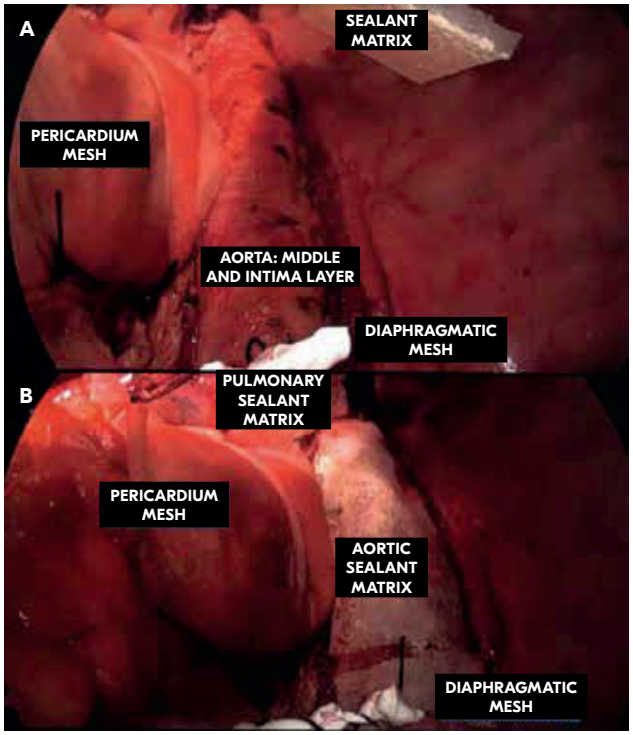
On the other hand, thanks to the introduction of cardio-vascular surgical techniques associated to lung cancer and the pre-operative care, the extended resections can improve the survival of very select patients[6].

Particularly, in the NSCLC surgery that invades the thoracic aorta controversies exist, both for the oncological prognosis as well as for the complex surgical approach the still represents a great challenge to the surgeons. In select cases, the surgical resection could be considered as an initial option or posterior to the induction treatment[6,7].

The resection of the tumor en bloc that invades the aorta using different techniques and intraoperative supports: extracorporeal circulation, passive aorta-atrium shunt (AA) and direct clamping or thoracic aortic endoprosthesis without extracorporeal circulation, provide security and improving postoperative management with encouraging results[7].

The coordination and cooperation among the thoracic and vascular surgical specialists is essential in these cases. In cases where the complete mural is affected the resection of the aortic wall can be performed leaving the endoprosthesis exposed. Some authors recommend using omentum coverage or synthetic parches. In our case, finding the cleavage plane between the adventitia and the media and interim layer, we have decided not to leave the endoprosthesis exposed, to avoid potential risks. To do so, it was sufficient to cover it with a medicated matrix. Unfortunately on the deep face of the adventitia outbreaks of neoplasic cells were observed, for which we cannot assure that they have not infiltrated the media and intima layers. Even though all of the other margins were negative, we consider it R1 at this level.

In spite of the reduction of morbimortality in the resection of the aortic wall with the placement of a thoracic aortic endoprosthesis, the risks of a spinal cord ischemia and paraplegia due to obstruction of the middle medullary artery (Adamkiewicz) are not at all negligible: from 1.5 to 13 % in different series. Permissive arterial hypertension, with drugs or volume augmentation, neuromonitoring could decrease this risk.

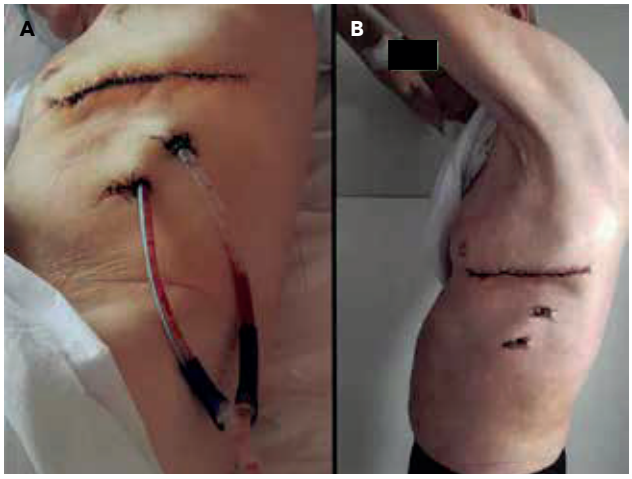


Images 10: Medicated sealing matrix. **A:** Inferior view of the descending aorta, showing the middle and intimal layers after resection of the adventitial layer in the area of tumor infiltration. The upper part of the image shows the medicated matrix prepared to be applied directly to the aortic layers to reinforce hemostasis. The lower end of the photo shows the PTFEe diaphragmatic mesh; the inner end shows the polyglactin 910 pericardial mesh.
B: View from under the medicated mesh used as sealants on the descending artery. The upper end of the image shows the same material for sealing air leakage in the culmen.

Some centers advocate the pre-operative placement of epidural catheters to maintain reduced tension of the cerebrospinal fluid after on-demand drainage. However, the complications of this technique can surpass in frequency and severity of the same spinal cord ischemia. Because of this, some authors advise strict postoperative control and proceed with controlled lumbar drainage using a pressure gauge only if neurological signs of spinal cord ischemia appear[8].

With respect to the infiltration of the left atrium, Galvaing and collaborators have published in their series 19 patients with resection of atrium infiltration to treat lung cancer between the years of 2004 and 2012. They described a morbidity of 53 % principally related to arrhythmias and a mortality of 11 %. The index of survival of 5 years was 44 %[9]. All of the series described are based on few cases, and are associated principally with poor prognoses.

Our final comment is that thanks to the cuff lingulectomy we avoided the pneumonectomy, associated with an important comorbidity. Although the definitive pathological anatomy result discarded malignancy at this level, we have opted for this procedure to resect the tumor en bloc due to the macroscopic and metabolic aspect seen in the presurgical images.



Images 11: Postoperative. **A:** Early postoperative period, with the drains still in place and connected to the vacuum system through a "Y" connection. **B:** Status of the thoracotomy prior to discharge. Extensive upper limb mobility can be observed from the early postoperative period.

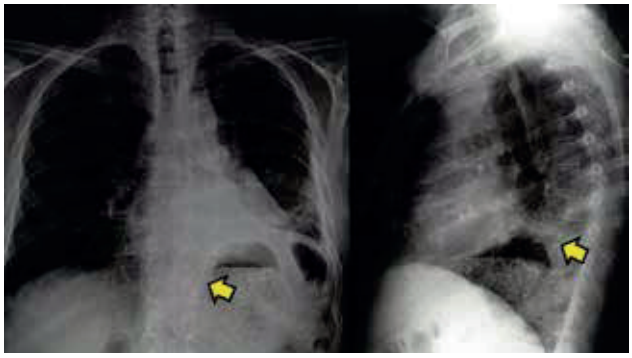


Image 12: Postoperative control. X-ray. Postoperative radiologic pair without incidences. Complete pulmonary re-expansion of the culmen. The image corresponding to the correctly positioned aortic prosthesis are identified with arrows.

BIBLIOGRAPHY

1. **Guberina N, Pottgen C, Schuler M, Guberina M, Stamatis G, Piones T, Krebs B, Metzenmacher M, Theegarten D, Gauler T, Jockel KH, Darwiche K, Aigner C, Stuschke M, Eberhardt WE.** Comparison of early tumour-associated versus late deaths in patients with central or >7 cm T4 N0/1 MO non-small-cell lung-cancer undergoing trimodal treatment: Only few risks left to improve. Eur J Cancer. 2020 Oct; 138: 156-168. doi: 10.1016/j.ejca.2020.07.025. Epub 2020. Sep 2. PMID: 32889370.
2. **Yildizeli B, Dartevelle PG, Fadel E, Mussot S, Chapelier A.** Results of Primary Surgery With T4 Non-Small Cell Lung Cancer During a 25-Year Period in a Single Center: The Benefit is Worth the Risk Ann Thorac Surg 2008; 86: 1065-75.
3. **National Comprehensive Cancer Network (NCCN).** Clinical practice guidelines in oncology. Non-Small Cell Lung Cancer 2019; 7.
4. **Kozower BD, Lamer JM, Detterbeck FC, Jones DR.** Special treatment issues in non-small cell lung cancer: diagnosis and management of lung cancer, 3rd ed: American College of Chest Physicians. evidence-based clinical practice guidelines. Chest 2013; 143: e369Se99S.
5. **Reardon ES, Schrump OS.** Extended resections of non-small cell lung cancers invading the aorta, pulmonary artery, left atrium, or esophagus: can they be justified? Thorac Surg Clin. 2014 Nov; 24 (4): 457-64 doi: 10.1016/j.thorsurg. 2014.07 .012. Epub 2014. Sep 11. PMID: 25441139; PMCID: PMC6301020.
6. **Wang XX, Liu TL, Yin XR.** Surgical treatment of IIIb-T4 lung cancer invading left atrium and great vessels. Cliin Med J (Engl), 2010 Feb 5; 12; 3(3): 265-8. PMID: 20193242.
7. **Marulli G, Rendina EA, Klepetko W, Perkmann R, Zampieri O, Maurizi G, Klikovits T, Zaraca F, Venuta F, Perissinotto E, Rea F.** Surgery far T4 lung cancer invading the thoracic aorta: Do we push the limits? J. Surg Oncol. 2017 Dec; 116 (8): 1141-1149. doi: 10.1002/jso.24784. Epub 2017 Sep 18. PMID: 28922454.
8. **Kemp C, Ikeno Y, Aftab M, Reece TR.** Cerebrospinal fluid drainage in thoracic endovascular aortic repair: mandatory access but tailored placement. Ann Cardiothorac Surg 2022; 11 (1): 53-55. doi: 10.21037/acs-2021-taes-12.
9. **Galvaing G, Tardy M, Cassagnes L, et al.** Left atrial resection for T4 lung cancer without cardiopulmonary bypass: technical aspects and outcomes. Ann Thorac Surg. 2014; 97 (5): 1708-13.

8

Left intrapericardial pneumonectomy with partial resection of the pulmonary trunk and left atrium

Rusca Giménez M, Gómez Tabales J, Roca Fernández FJ, Illiana Wolf J, López García C, Espinosa Jirnénez D

Hospital Universitario Puerta del Mar, Cádiz

Introduction

The locally advanced non-small lung cancer cell tumors that invade the surrounding structures in the thorax (T4) are a heterogenous group and there is no standard procedure in clinical practice[1].

In general, the surgical treatment of these T4 tumors is controversial. However, there are selected T4 N0-1 M0 (stage IIIA) that can be candidates for surgery[2].

The case is presented of a patient with a bronchogenic tumor in the left upper lobe with mediastinal extension and to the left principal pulmonary artery. A pneumonectomy with complete macroscopic resection of the tumor is performed.

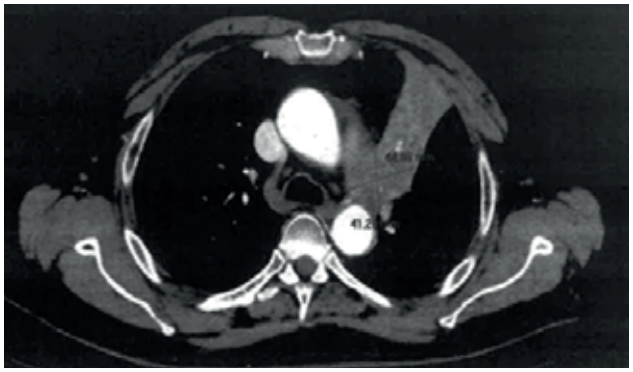


Image 1: Preoperative axial slice of chest CT that shows the dimensions of the left para hilar mass.

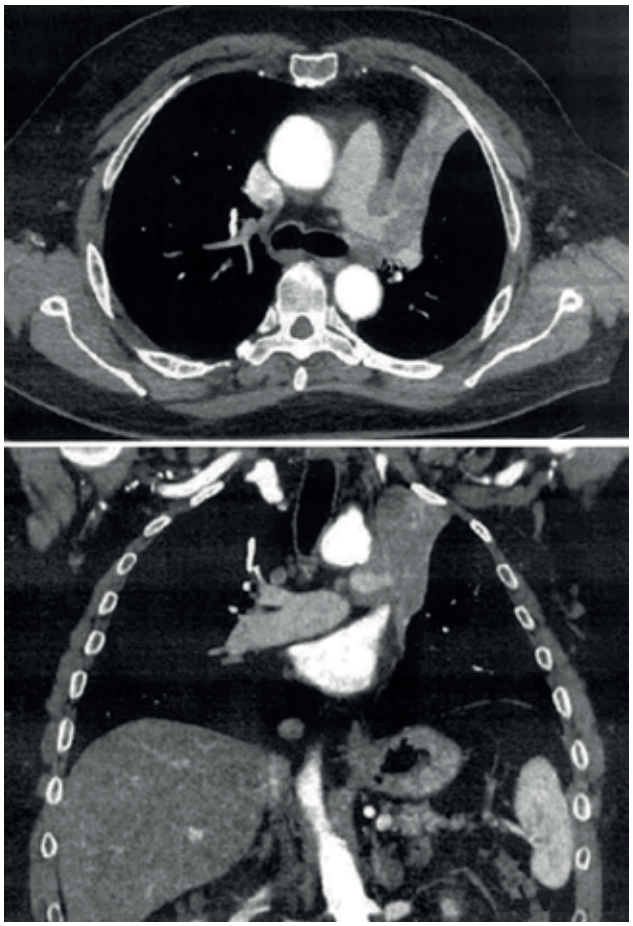


Image 2: Axial and coronal slices of the preoperative chest CT scan showing the left parahilar mass with complete atelectasis of the left upper lobe. It can be seen how the mass engulfs and narrows the left pulmonary artery with a critical decrease in the caliber of the lobar artery for the LUL and for the LLL.

Clinical case

Male of 62 years of age, with history of arterial hypertension, diabetes mellitus 2, dyslipidemia, bronchial asthma and an important tobacco load, being an ex-smoker for 10 years with an average cigarette consumption of 35 packs/year.

Under study by Pneumology due to progressive dyspnea and persistent dry cough of 6 months of evolution with slight hemoptysis, normal cardiopulmonary auscultation and an anodyne chest X-ray. A CT scan of the chest was requested which showed a left parahilar spiculated tumor of 41 x 45 x 50 mm (APxTTxCC) *(→ Image 1)* compatible with a neoplastic process engulfing the principal left pulmonary artery, as well as the left main bronchus less than 2 cm from the carina, with complete obstructive atelectasis of the secondary LUL (T3-4N0Mx) *(→ Images 2 and 3)*.

A fibrobronchoscopy was requested that described the total obstruction of the LUL bronchus opening and biopsies of the lesion were taken that concluded with the diagnosis of squamous cell carcinoma.

The analytical studies and the functional respiratory tests were within normal ranges. In the PET, the hilum mass presented an increased pathological metabolism, but no mediastinal or contralateral adenopathies affected or evidence of hyper metabolic lesions were observed at other levels. With EBUS, a scan of the mediastinum was performed without objective ultrasound signs of malignancy and no observation of puncture subsidiary adenopathy's.

Given the good condition of the patient, after an exhaustive cariology study and discarding the possible affectation of the adenopathies with the PET and EBUS, surgical resection of the tumor was proposed.

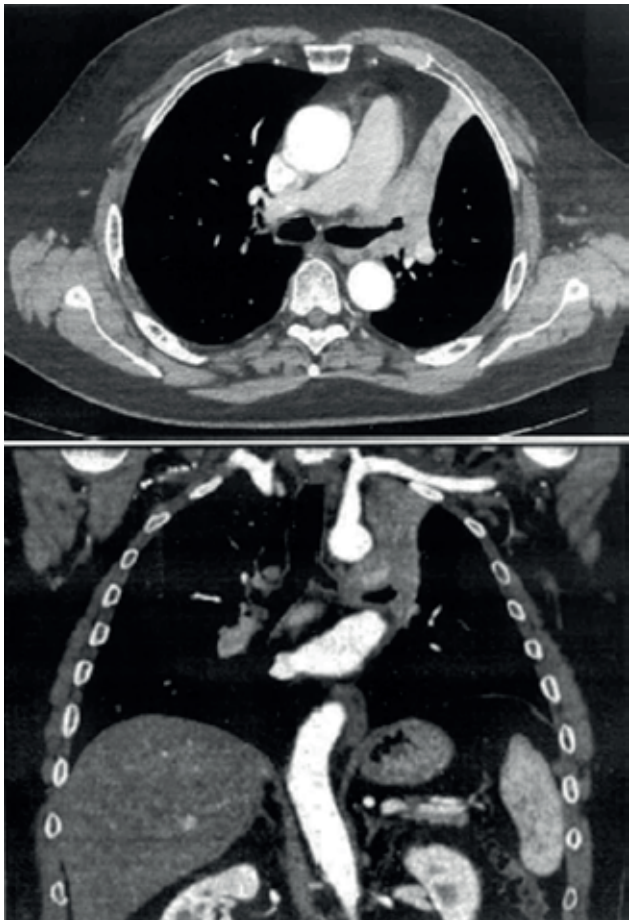


Image 3: Axial and coronal slices of the preoperative chest CT scan showing the mass constricting the left main bronchus with amputation of the entire upper lobar bronchus.

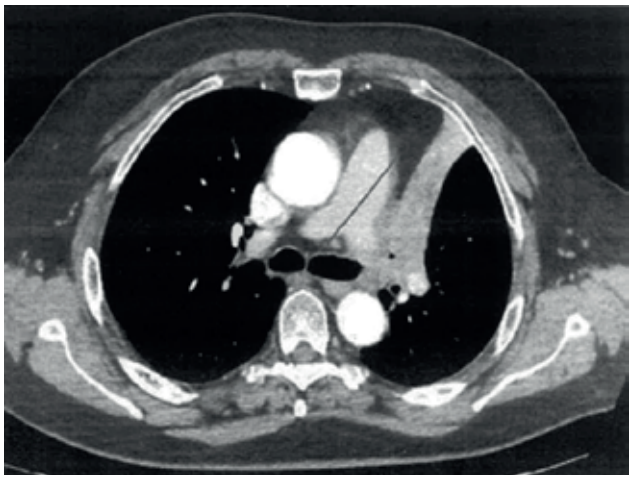


Image 4: Preoperative axial chest CT scan showing the line of pulmonary artery resection performed (green line), leaving sufficient caliber for the right pulmonary artery.

Surgical technique

Under general anesthesia with selective intubation, placement of an epidural catheter placement and bladder catheterization, the patient is placed in right lateral decubitus with the arm in antepulsion and the left post lateral thoracotomy is performed.

A complete exploration of the pleural cavity was performed finding the hilar tumor that progresses intrapericardially up to the main pulmonary artery.

After the dissection of the different structures, an left intrapericardial pneumonectomy was performed with partial section of the pulmonary trunk, leaving sufficient space for the flow of the right lung with endografting *(→ Image 4)*.

Due to the tumor infiltration it was necessary to section the left atrium including the two left pulmonary veins. The main left bronchus was sectioned and a radical lymphadenectomy was performed on the groups 5, 6, 7, 8, 9, and 10L *(→ Images 5 and 6)*. The hemostasis of the pulmonary artery suture that presented a small hemorrhage was improved with TachoSil® *(→ Image 7)*.

Pleural drain remained in place, which was removed on the 2nd postoperative day after the absence of air leakage was observed and due to the presence of scarce debit.

The patient evolved satisfactorily, with good mechanical ventilation, good pain control and radiological controls within normal range. Discharge was indicated 4 days after the intervention *(→ Image 8)*.

The pathologic anatomy study confirmed the diagnosis of moderately differentiated squamous cell carcinoma (G2) with a maximum axis of 5.5 cm in the upper lobe of the left lung with metastasis in a hilar ganglion (1/5) and bronchovascular invasion. The mediastinal ganglion. that was removed were free of metatastic illness. The pathologic staging was pT4pN1.

Currently, the patient is pending evaluation by Medical Oncology.

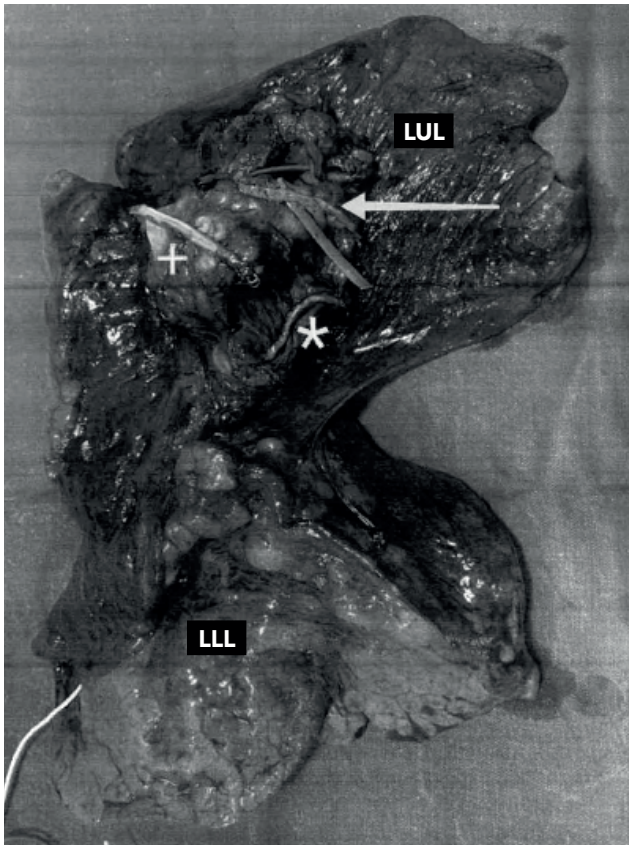


Image 5: Surgical bed after completion of the left pneumonectomy. The resection suture of the left pulmonary artery can be seen (marked with an arrow) and the remaining right pulmonary artery. The suture of the left atrium is identified (marked with an asterisk) as well as the principal left bronchial suture (marked with a cross).

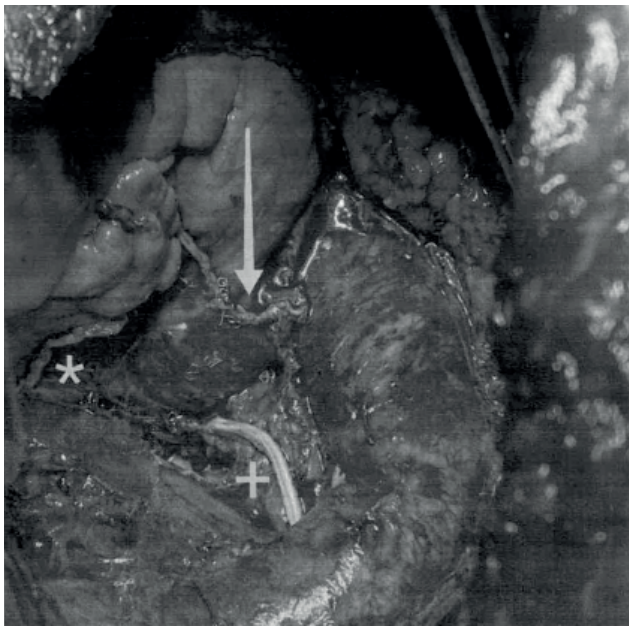


Image 6: Surgical piece of the left lung en bloc with the trunk of the left pulmonary artery (marked with an arrow), part of the left atrium (marked with an asterisk) and principal left bronchium (marked with a cross). The tumor is located in the upper lobe.

Discussion

According to the current edition (8th) of the TNM classification, T4 tumors are considered all of those with a size >7 cm, the tumors of any size that invade the mediastinum, heart, diaphragm, carina, trachea, large vessels, recurrent larynx nerve, esophagus or vertebral body, o including the presence of separate tumor nodes in another ipsilateral lobe different from the principal tumor[3].

The optimum treatment of locally advanced T4 non-small lung cancer cells continues to be controversial and is still being debated. The surgery is a pillar of the treatment in a subgroup of patients with resectable T4 N0/1 M04 tumors. Unlike the T4 tumors of the upper sulcus, the use of neoadjuvant therapy for central T4 tumors is not clearly defined. Review of current literature does not show a consensus that confirms that in these cases neoadjuvant therapy is more advantageous than initial surgery[1].

When considering the resection of a T4 tumor, it is imperative to radiologically stage the patient and perform the invasive mediastinal staging[5], The presence of N2 disease, particularly if it is a multi-station, is a factor for a bad prognosis that would contraindicate surgery as a therapeutic option.

The most important determining factors for a successful result after the surgery are to achieve a curative resection (RO) and avoid the incidental pathological N2 disease[1]. A consensus exists in that the survival rate of 5 years is greater in patients with a complete surgical resection than in those with a partial resection (37.5 – 46.2 % vs. 10.9 – 22.4 %, $p<0.05$)[6].

Surgical retrospective series have described survival rates of 5 years between 15 and 33 % in T4 N0/1 tumors, depending on the anatomical structure involved[2].

Lung cancer with cardiovascular invasion, particularly in the left atrium, occurs in up to 10 % of patients with primary pulmonary cancer. The extended pneumonectomy with partial resection of the atrium is a feasible option to treat these cases, when total resection of the entire tumor is achieved.

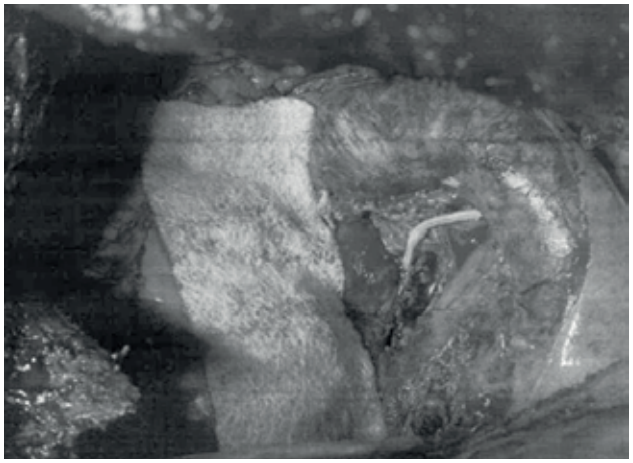


Image 7: Application of TachoSil® on the suture of the resection of the pulmonary artery for hemostatic purposes.

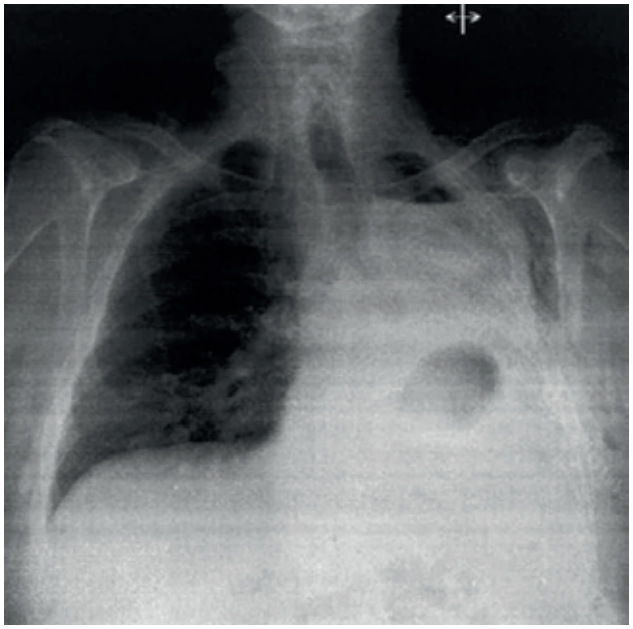


Image 8: Portable chest X-ray on discharge.

In the cases in which the left atrium resection does not require the dissection of the interatrial septum, this can be performed without the need for extra corporeal circulation[6], The survival rate of 5 years and the mortality in these cases oscillates between 14 – 30 % and 0 – 10 %, respectively[7].

Conclusion

The complete surgical resection "en bloc" of the bronchogenic tumors with invasion of mediastinal structures (T4), in very select cases and once ganglion affectation N2 (stage IIIA) is discarded, can significantly improve the survival of the patients.

Nonetheless, the surgical treatment of this cases continues to be controversial and is associated with a high postoperative mortality rate and morbidity. Therefore, it is essential to perform more studies to reach a consensus on the therapeutic actions.

BIBLIOGRAPHY

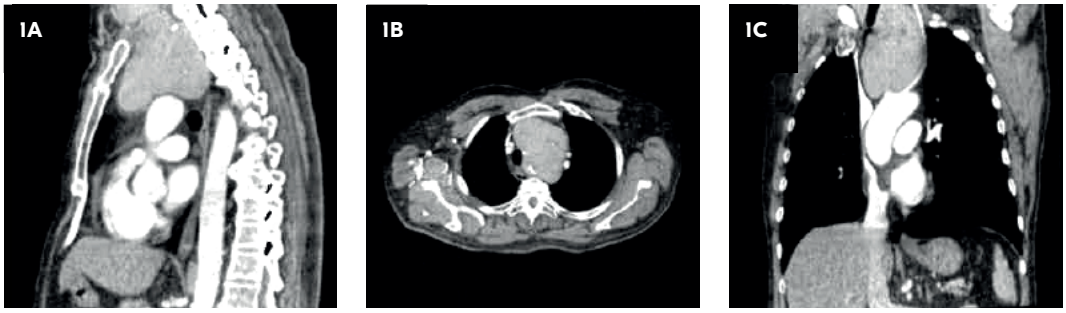
1. **Ilonen I, Jones DR.** Initial extended resection or neoadjuvant therapy for T4 non-small cell lung cancer-What is the evidence? Shanghai Chest. 2018; 2:76.9. Galvaing G, Tardy M, Cassagnes L, et al. Left atrial resection for T4 lung cancer without cardiopulmonary bypass: technical aspects and outcomes. Ann Thorac Surg. 2014;97(5): 1708-13.
2. **Guberina N, Pottgen C, Schuler M, Guberina M, Stamatis G, et al.** Comparison of early tumour-associated versus late deaths in patients with central or > 7 cm T 4 N0/1 M0 non-small-cell lung-cancer undergoing trimodal treatment: Only few risks left to improve. European Journal of Cancer. 2020; 128: 156-168.
3. **Montagne F, Guisier F, Venissac N, Baste JM.** The Role of Surgery in Lung Cancer Treatment: Present Indications and Future Perspectives-State of the Art. Cancers. 2021 Jul 23;13(15):3711.
4. **Kozower BD, Lamer JM, Detterbeck FC, Janes DR.** Special treatment issues in non-small cell lung cancer: Diagnosis and management of lung cancer, 3rd ed: American College of Chest Physicians evidence-based clinical practice guidelines. Chest. 2013 May;143(5 Suppl):e3695-e399S.
5. **Eberhardt WE, De Ruysscher D, Weder W, Le Péchoux C, De Leyn P, Hoffmann H, Westeel V, Stahel R, Felip E, Peters S.** Panel Members. 2nd ESMO Consensus Conference in Lung Cancer: locally advanced stage 111 non-small-cell lung cancer. Ann Oncol. 2015 Aug;26(8):1573-88.
6. **Yuan SM.** Extended pneumonectomy for advanced lung cancer with cardiovascular structural invasions. Turk Gogus Kalp Dama. 2018;26(2):336-342.
7. **Yokoi K, Taniguchi T, Usami N, Kawaguchi K, Fukui T, Ishiguro F.** Surgical management of locally advanced lung cancer. Gen Thorac Cardiovasc Surg. 2014 Sep;62(9):522-30.

9

Use of TachoSil® as a hemostatic agent and sealant after the resection of the intrathoracic goiter through partial cervical-sternotomy

Fuentes-Martín A, Victoriano Soriano GI, Soro-García J, García Rico CB, Gregario Crespo B, Matilla González JM

Hospital Clínico Universitario de Valladolid

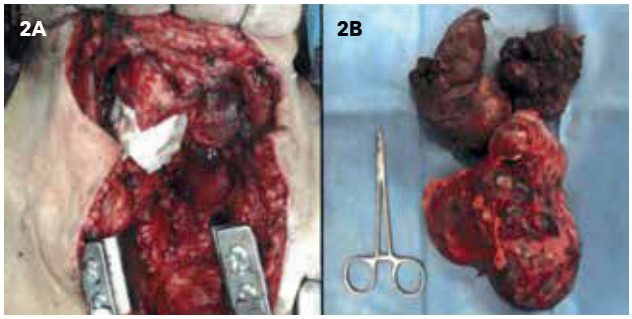


Images 1A, 1B and 1C: Sagittal, axial and coronal slices of preoperative computed tomography. Mass is located at the anterior and middle mediastinal level with mass effect on adjacent structures.

Introduction

Endothoracic goiter is defined as an abnormal enlargement of the thyroid gland and can be associated with different descriptions: diffuse or nodular, toxic, single episode or hypothyroidism associated or not to autoimmune thyroid[1]. Generally, it is located in the cervical region (85 – 90 %) versus a minority of cases where its extension may be intrathoracic (10 – 15 %)[2]. Unlike cervical goiters, the intrathoracic goiters often cause symptoms due to compression of adjacent structures[3].

Total thyroidectomy using a standard cervical approach is accepted as the surgical treatment of choice, reserving the combination with other approaches for when resection is not feasible from the technical point of view[4].



Images 2A: Interoperative image after the application of TachoSil® on the surgical bed. **2B:** Surgical resection of multinodular goiter with endothoracic extension. Visual reference of mosquito forceps with length of 12.5 cm.

Clinical case

We present the clinical case of a 73 year-old male referred by external consultants from Internal Medicine due to suspicion of an endothoracic goiter after an incidental finding in an axial computed tomography (CAT) for additional study after a recent diagnosis of localized prostate adenocarcinoma. No other medical or surgical history of interest.

The patient had not made a prior consultation in spite of the evident increase in volume at the cervical level and refers, under direct interrogation, to clinical suggestion of extrinsic compression of the upper airway, such as changes in the tone of voice and progressive respiratory difficulty evolving over months.

In the physical exploration a tumor is observed at the cervical level with clear palpable mediastinal extension on swallowing. The left Pemberton sign was positive.

The cervical-thoracic axial computed tomography showed a diffuse enlargement of the thyroid gland, with several bilateral nodular images, compatible with multinodular goiter. At the mediastinal level a mass is located in the anterior and mid-left compartments, well defined, with lobulated contours, with numerous coarse calcifications and some small hyperdense areas in its interior, approximately 11 x 8.2 x 10.5 cm in diameter anteroposterior, transverse and craniocaudal, respectively, with mass compressing and displacing the trachea and the esophagus to the right, and displacing the common carotid and left subclavian arteries to the left. In addition, there was evidence of imprinting on the left main bronchus and the aortic arch.

No sizeable adenopathies or with pathological aspects were identified. In the pulmonary parenchyma no suggestive nodular images of secondary metastasis were visualized (→ *Images 1A, 1B and 1C).*

After a multidisciplinary valuation and in accordance with the patient's will, it was decided to perform a total thyroidectomy. A fine needle preoperative aspiration biopsy was not performed, due to the presence of multiple confluent nodes and the intrathoracic thyroid extension.

Using general anesthesia with selective intubation and positioning in supine decubitus with cervical hyperextension an initial approach by Kocher cervicotomy was performed.

The first step was the dissection of the carotid arteries and the jugular veins and the exposure of the recurrent larynx nerves in conjunction with the identification and dissection of the superior and inferior parathyroid glands. A left hemithyroidectomy was performed confirming the important intrathoracic extension, and it was not possible to complete the resection through the cervicotomy. Next, the right hemithyroidectomy continued, completing the resection by performing a partial sternotomy with extension to the manubrium and proximal portion of the sternal body freeing up the intrathoracic component and extracting the left hemithyroid. After the hemostatic verification, a medicated matrix (TachoSil®) for the control of the hemostasis and the sealing of the cervical thyroidectomy bed *(→Images 2A and 2B)*. Two cervical drains (15 Fr) and a mediastinal retrosternal drain (20 Fr) were inserted. The partial sternotomy was closed with steel wire sutures.

The postoperative period transpired without incidence, progressively removing the drains without the appearance of complications. Analytically, the patient presented asymptomatic hypocalcemia that required prolonging the hospital stay until normal parameters were achieved through the administration of calcium supplements and vitamin D. The patient was discharged 8 days after admittance to the hospital.

The definitive histological result was compatible with nodular thyroid hyperplasia. The intrathoracic component of the pathological anatomy analysis reflected a weight of 368 grams with approximate measurements of 13 x 9 x 9 cm.

During the postoperative control in external consults the thyroid function tests and the determination of the concentrations of serum calcium were reported to be within normal parameters.

Discussion

The approach to surgical treatment of endothoracic goiter continue to be a subject of conversation.

The transversal cervicotomy of Kocher incision is the most used surgical approach. It is estimated the around 90 % of all of the thyroids with intrathoracic components can be removed using this technique[5]. However, there exist a minor number of patients in which it is necessary to adopt a cervical-thoracic approach, when faced with the technical impossibility of cervical extraction, be it due to the location, the size or the relation of the mass to the adjacent mediastinal structures. The media or total sternotomy, the thoracotomy and the thoracoscopy are different surgical approached used in the resection of this pathology[6].

The use of the median sternotomy, as in the aforementioned case, continues to be the preferred approach with large endothoracic masses and/or that compromise the mediastinal vascular structures, since multiple studies have shown that this type of patient presents a greater probability both of postoperative complications as of re-interventions and death[7].

TachoSil® usage in the surgical bed in these cases, due to its hemostatic properties and adaptability to ensure adequate tissue coagulation, diminishes the use of heat producing electric hemostasis devices, reducing tissue damage and consequently the risk of injuries to the recurrent laryngeal nerves[8].

BIBLIOGRAPHY

1. **Hegedüs L, Bonnema SJ, Bennedbaek FN.** Management of simple nodular goiter: current status and future perspectives. Endocr Rev. 2003 Feb;24(1):102-32. doi: 10.1210/er.2002-0016. PMID: 12588812.
2. **Perincek G, Avci S, Celtikci P.** Retrosternal Goiter: A couple of classification methods with computed tomograpy findings. Pak J Med Sci. 2018 Nov-Dec;34(6):1494-1497. doi: 10.12669/pjms.346.15932. PMID: 30559810; PMCID: PMC6290211.
3. **Doulaptsi M, Karatzanis A, Prokopakis E, Velegrakis S, Loutsidi A, Trachalaki A, Velegrakis G.** Substernal goiter: Treatment and challenges. Twenty-two years of experience in diagnosis and management of substernal goiters. Auris Nasus Larynx. 2019 Apr;46(2):246-251. doi: 10.1016/j.anl.2018.07.006. Epub 2018 Jul 25. PMID: 30055961.
4. **Nankee L, Chen H, Schneider DF, Sippel RS, Elfenbein DM.** Substernal goiter: when is a sternotomy required? J Surg Res. 2015 Nov;199(1):121-5. doi: 10.1016/j.jss.2015.04.045. Epub 2015 Apr 18. PMID: 25976851; PMCID: PMC4793957.
5. **Ríos A, Rodríguez JM, Galindo PJ, Torres J, Canteras M, Balsalobre MD, Parrilla P.** Results of surgical treatment in multinodular goiter with an intrathoracic component. Surg Today. 2008;38(6):487-94. doi: 10.1007/s00595-006-3673-z. Epub 2008 May 31. PMID: 18516526.
6. **De Aguiar-Quevedo K, Cerón-Navarro J, Jordá-Aragón C, Pastor-Martínez E, Sales Badia JG, García-Zarza A, Pastor-Guillén J.** Bocio intratorácico. Review of medical literature [intrathoracic goiter: a literature review]. Cir Esp. 2010 Sep;88(3):142-5. Spanish. doi: 10.1016/j.ciresp.2010.03.020. Epub 2010 May 24. PMID: 20494348.
7. **Sancho JJ, Kraimps JL, Sanchez-Blanco JM, Larrad A, Rodríguez JM, Gil P, Gibelin H, Pereira JA, Sitges-Serra A.** Increased mortality and morbidity associated with thyroidectomy for intrathoracic goiters reaching the carina tracheae. Arch Surg. 2006 Jan;141(1):82-5. doi: 10.1001/archsurg.141.1.82. PMID: 16415416.
8. **Rickenbacher A, Breitenstein S, Lesurtel M, Frilling A.** Efficacy of TachoSil® a fibrin based haemostat in different fields of surgery a systematic review. Expert Opin Biol Ther. 2009 Jul;9(7):897-907. doi: 10.1517/14712590903029172. PMID: 19527109. Cardiovasc Surg. 2014 Sep; 62 (9): 522-30.

10

Prevention and treatment of air leak with a human fibrinogen thrombin patch (TachoSil®), a case report

Lora Ibarra A, Díaz Sanz B, García Rodríguez O, Rey Gutama H, Muñóz González N, García Tirado FJ

Hospital Universitario Miguel Servet, Zaragoza

Introduction

According to various studies, air leakage (AL) is produced in more than 50 % of patients that undergo pulmonary resection surgeries and among these persistent air leakage (PAL) is between 15 and 18 %[1-3]. Various risk factors have been identified for the development of AL, including: deficient pulmonary function, emphysema, upper lobectomy and bi-lobectomy, re-interventions, the presence of adherences and treatment with steroids[4].

The majority of the AL in the immediate postoperative period are benign and are resolved within a few days[2]. Nonetheless, the PAL are associated with greater postoperative complications, prolong hospitalization and higher hospital costs. The PAL has traditionally been defined as any AL that continues after the 7th postoperative day, although more recently this definition has been reconsidered and modified to any AL that persists more than 5 days, which is the average hospital stay after a lobectomy[4,5].

It is well known that preventing the appearance of air leaks reduces the probability of complications and shortens the hospital stay[4,5] which also has a positive impact on costs[6]. With respect to this various techniques, to reduce or attempt to minimize postoperative AL, include the reinforcement of the line of staples and the use of glues or surgical sealants[3-5].

One of these sealants is the human fibrinogen thrombin patch (TachoSil®). The efficacy and security of this product as a sealing agent in thoracic surgery has been demonstrated in various studies to prevent AL after pulmonary resection[2,5,6].

Currently it is indicated for adults as support treatment in surgery to improve hemostasia, promote tissue sealing and as a reinforcement for sutures in anastomosis or vascular stumps[5,6].

Here we present a clinical case of a patient after pulmonary resection surgery that presented bleeding and significant air leakage requiring re-intervention where it was decided in this case to use human fibrinogen and thrombin patch (TachoSil®) to improve hemostasia and promote tissue sealing with good results.

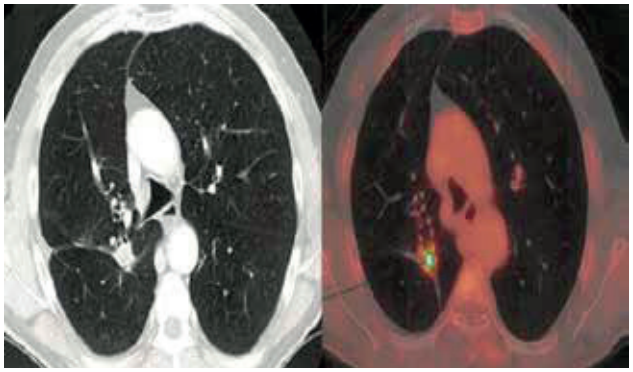


Image 1: CT and PET CT that shows the appearance of a metabolically active suspicious node in the RSL contiguous to the surgical suture attributable to the local relapse.

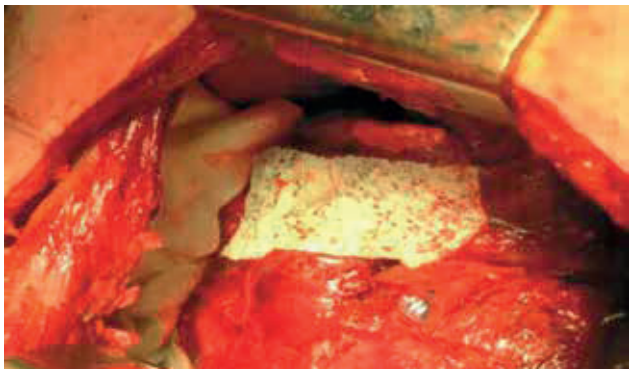


Image 2: Application of the human fibrinogen and thrombin sealant matrix (TachoSil®), 1 – 5 patches.

Clinical case

It is a 72 year-old male with a personal history of ATH, ex-smoker with IPA 80, severe COPD, and history of SARSCoV2 infection 3 months prior to the intervention without respiratory failure. History of pulmonary squamous cell carcinoma in right superior lobe (RSL), T2N0M0, treated with a surgical pulmonary resection atypical due to deficient respiratory function tests (RFTs). In follow-up by the Medical Oncology Service, in image tests a possible local relapse in a surgical suture 7 years after the primary intervention *(→ Image 1)* deciding to perform a complete lobectomy of the RSL and lymphadenectomy by thoracotomy. The dissection was difficult being a re-intervention with a recent history of pulmonary infection and multiple firm adhesions requiring adhesiolysis and detachment of lung parenchyma, giving way to areas of lacerated parenchyma and devoid of visceral pleura. After perming the lobectomy ne sealant was applied.

The patient has a torpid evolution in the immediate postoperative period with significant air leakage (500 to 1,000 ml/min quantified by Thorpaz system with aspiration at -8) and bleeding, requiring emergency reintervention after 24 h. In this case, drainage of clotted hemothorax and revision of hemostasis and aerostasis are performed. The cavity is thoroughly examined without locating a clear bleed point, only light sheet bleeding is observed from some points in the parietal pleura that are coagulated using an electro scalpel; Aerostasis is controlled under water demonstrating a significant alveolar leak at the level of the areas of parenchymatous depleuralization over which we placed the TachoSil® *(→ Image 2)*, covering as well the vascular stumps. The hemostasis is reinforced with other hemostatic agents on the wall and the seal of the of bronchial stump with good re-expansion of remaining parenchyma are tested. On this occasion, upon leaving the operating room the leak had reduced considerably after the application of the TachoSil® patches, in this case quantified by the Thoraz system at 100 ml/min, aspiration -20. The leak ceases completely 72 hours after the re-intervention.

The patient has a favorable immediate postoperative period without new bleeding episodes and with the air leak resolved.

Discussion

The standard intra-operatory procedures to prevent or reduce air leaks include sutures, the us of staplers with protective covers and the use of electromechanical devices. Nonetheless, the use of sealants or glues has grown in recent years, with more products available every day[1,3,7]. However, there is still no clear consensus about the application of these products to reduce the incidence of postoperative AL in thoracic surgery[6].

In our service we do not systematically use tissue sealants in pulmonary resection surgery. The important factors for deciding on their application, independently of the product (which is chosen based on the surgeon's criteria) are: the intensity of the air leak evaluated by a test of immersion under water and the quality of the pulmonary tissue.

In the clinical case in question TachoSil® was used with a dual purpose: to help with hemostasis since there had been previous bleeding and with the intention of reducing the initial air leakage that reached up to 1,000 ml/min and that after the use of the patch was reduced to 100 ml/min with the same ceasing 72 hours postoperative: This would advocate, according to our experience, in favor of its properties as a tissue sealant and coincides with that described in the literature, given that studies exist that demonstrate the efficacy and efficiency of TachoSil® to reduce AL inter- and postoperative, the time until the removal of the thoracic drainage and the duration of the hospital stay in comparison with the standard surgical treatment of air leaks[2,4,5-9].

This in turn returns an economic benefit, derived from a shorter hospital stay and lower consumption of hospital resources[8].

Conclusion

- Air leaks are a frequent post operative complication in our specialty.
- The application of tissue sealants is efficient and secure for the prevention of postoperative air leaks, especially in patients with severe emphysema.
- There is not a current consensus about when to use a tissue sealant or which to use, nonetheless, and according to reviewed studies, the use of human fibrinogen and thrombin patches (TachoSil®) is safe, is not associated with postoperative complications and has a potential benefit of reducing the possibility of complications, the hospital stay and costs.
- New randomized studies that identify the optimum indications for the application of surgical sealants are required.

ABBREVIATIONS

ACT: Axial Computed Tomography
AL: Air leak
ATH: Aterial Hypertension
COPD: Chronic Obstructive Pulmonary Disease
IPA: Index of Packs/Year
PAL: Persistent air leak
RFT: Respiratory Function Tests
RSL: Right Superior Lobe

BIBLIOGRAPHY

1. **Ruffini E, Filosso PL.** Addressing a missing point: The short- and long-term effects of a lung sealant patch. The Journal of Thoracic and Cardiovascular Surgery. 2015; 149:989-90.
2. **Filosso PL, Ruffini E, Sandri A, Lausi PO, Giobbe R, Oliaro A.** Efficacy and safety of human fibrinogen-thrombin patch (TachoSil®) in the treatment of postoperative air leakage in patients submitted to redo surgery for lung malignancies: a randomized trial. 2013.
3. **Wain JC, Kaiser LR, Johnstone DW, Yang se, Wright CD, Friedberg JS, et al.** Trial of a novel synthetic sealant in preventing air leaks after lung resection. The Annals of Thoracic Surgery. 2001 May 1;71(5):1623-9.
4. **Burt BM, Shrager JB.** The Prevention and Management of Air Leaks Following Pulmonary Resection. Thoracic Surgery Clinics. 2015 Nov 1;25(4):411-9.
5. **Nishida T, Mikami I, Fujii Y.** New technique to prevent prolonged air leak: use of "Tachosuture" technique. Gen Thorac Cardiovasc Surg. 2017 Feb 1;65(2):133-6.
6. **Zhou J, Lyu M, Pang L, Gao Y, Ning K, Wang Z, et al.** Efficiency and safety of TachoSil® in the treatment of postoperative air leakage following pulmonary surgery: a meta-analysis of randomized controlled trials. Japanese Journal of Clinical Oncology. 2019 Sep 1;49(9):862-9.
7. **Moser C, Opitz I, Zhai W, Rousson V, Russi EW, Weder W, et al.** Autologous fibrin sealant reduces the incidence of prolonged air leak and duration of chest tube drainage after lung volume reduction surgery: A prospective randomized blinded study. The Journal of Thoracic and Cardiovascular Surgery. 2008 Oct;136(4):843-9.
8. **Anegg U, Lindenmann J, Matzi V, Smolle J, Maier A, Smolle-Jüttner F.** Efficiency of fleece-bound sealing (TachoSil®) of air leaks in lung surgery: a prospective randomized trial. European Journal of Cardio-thoracic Surgery. 2007 Feb;31(2):198-202.
9. **Zhang R, Bures M, Hoffler K, Jonigk D, Haverich A, Krueger M.** In vitro comparison of two widely used surgical sealants for treating alveolar air leak. Thorac Cardiovasc Surg. 2014;62(8):705-9.

11

Synchronous and bilateral pulmonary adenocarcinoma

Montesinos Encalada M, Libreros Niño A, Sampedro Salinas C, Rombolá C

Hospital Universitario Amau de Vilanova, Lleida

Introduction

Lung cancer continues to be the primary cause of death in Spain for both sexes, and among women, the mortality for lung cancer in 2017 increased by 6.4 % with respect to prior years[1].

There does not exist a clear explanation for their mortality rate. However, it is known that genetic and environmental factors intervene, as well as oncological treatment. To the degree that the incidence of lung cancer increases, the number of patients diagnosed with multiple primary pulmonary cancer (MPPC) also increases.

Martini and Melamed[3] established 1,975 diagnostic criteria for MPPC. Although accepted by the majority of the authors, there does not currently exist a unified model for the diagnosis, which, in addition to the variability of the series studied, could explain the differences obtained related to its prevalence.

We can differentiate between synchronous tumors, if they appear simultaneously, or metachronal, if the intermission of the appearance is superior to two years, with this being the most frequent case, generally diagnosed in surgically intervened patients in which a new pulmonary infiltration appears in the radiological controls.

Although differentiating between MPPC and intrapulmonary metastasis of lung cancer is important for the treatment strategy and prognosis, it is also very complicated, particularly in the cases with similar hystologies.

The treatment of choice for patients with MPPC in stage I-II is surgical resection that provides a better option with potential cure for these patients (I, B)[4]. The recommended surgery if the patient is medically apt is a lobectomy or anatomic pulmonary resection instead of the sub-lobar resection (I, B). The resection is also recommended for patients with positive margins in stage I-II relapse. If it is not possible, postoperative radiology can be considered[4].

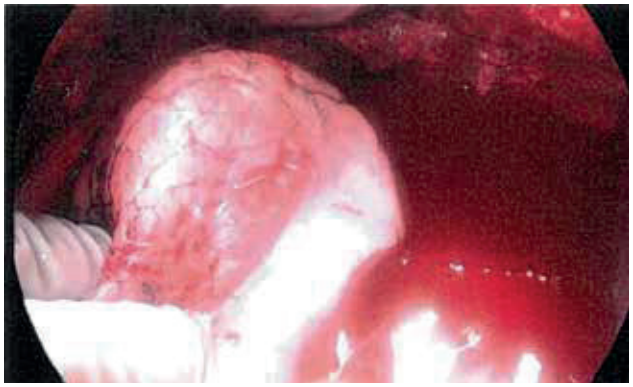


Image 1: Laceration and depleuralization areas in left superior lobe.

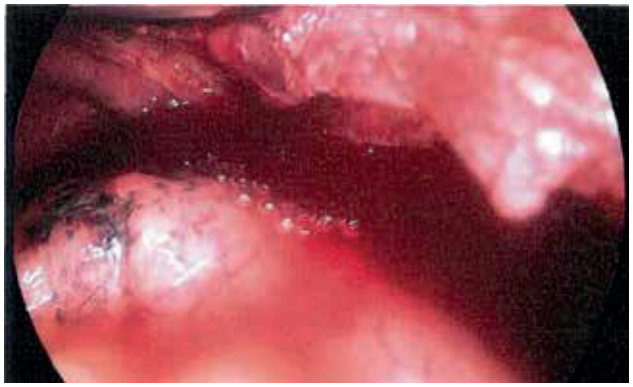


Image 2: Ari leak in the depleurization area during the aero stasis test.

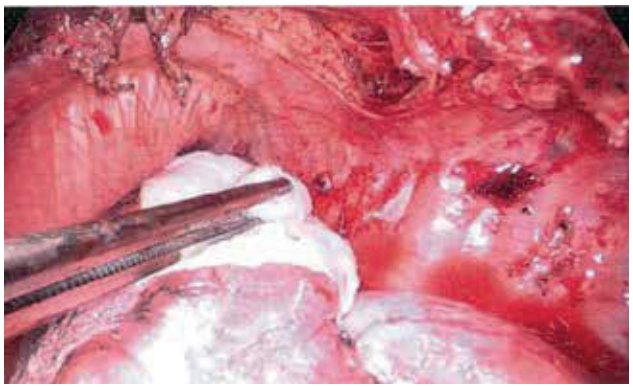


Image 3: Placing a collagen matrix on the depleurized area with a small moist swab.

Image 4: Adherence of the medicated matrix to the pulmonary tissue.

Clinical case

A 64 year-old patient with history of right hemicolectomy for moderately differentiated adenocarcinoma T3cN0Mx in 2018, that presented 2 synchronous lesions in ground glass opacity in both lower lobes (20 mm at base of right and 14 mm at base of left) both suspected to be malignant (adenocarcinoma). Atypical VATS resection was performed on the left lesion (June 2019) with deferred pathological anatomy results of well differentiated adenocarcinoma of pulmonary origin of 1 cm (T1a), with posterior negation on behalf of the patient to complete the surgical resection as well as any other complementary treatment. After 18 months in the radiological controls the appearance of 2 micro-nodules are observed in the left base close to the area where the surgical resection was previously performed, as well as a larger solid component of the right basal lesion. Due to these changes, the sequential surgical resection of both lesions is recommended to the patient who finally accepts. A right inferior lobectomy VATS (October 2021) is performed with a pathological anatomy diagnosis of poorly differentiated adenocarcinoma of a predominantly papillary pattern T3N0Mx (identifying 3 nodular lesions in the piece).

After 5 months (March 2022) a surgical re-intervention of a total left inferior lobectomy with a pathological anatomy diagnosis of moderately differentiated adenocarcinoma with a predominately papillary pattern of 2.5 cm T2bN0Mx with respect to the previous atypical resection (being superimposable to the morphology of the previously resected lesion in the atypical resection, demonstrating a recurrence of the lesion) with focal presence of STAS pattern.

During the performance of the total left inferior lobectomy, as it was a surgical re-intervention, multiple firm pulmonary adhesions were found, a laceration of the pulmonary parenchyma at the apical and cisural levels was produced *(→ Image 1)* demonstrating depleurized zones with air leakage during the aerostasis maneuver *(→ Image 2)*, so a collagen matrix was placed in said areas *(→ Image 3)*, verifying after two minute the adequate adhesion of the product to the pulmonary tissue no further air leaks were identified in the posterior aerostasis test *(→ Image 4)*.

Patient has a favorable post operative period, pain adequately controlled, no fever, no evidence of air leak during the postoperative period so thoracic drainage is removed with the subsequent discharge from the hospital at 72 hours.

Discussion

The existence of multiple pulmonary neoplasias are an infrequent event, with few cases described in existing literature. Multiple primary pulmonary tumors can appear synchronously (simultaneous appearance), or meta chronic (difference of appearance greater than two years.) with the latter being the most common. The prognosis in patients that present synchronous tumors seem to more unfavorable than in the patients with cancer in only one lung.

There exist various diagnostic criteria used in the bibliography to consider two or more synchronous tumors, such as the Martini and Melamed[3] criteria or the Wu criteria, the latter being the most recently updated:

1. each tumor must be malignant;
2. the tumors must be anatomically different and separated;
3. the tumors must be histologically different;
4. if the histology is the same in the synchronous tumors each tumor must have its own place of origin, without invading lymphatic ganglion;
5. each tumor must have its own metastasis;
6. no findings of extra pulmonary metastasis.

The most frequent histology of synchronous tumors is squamous tumors, with treatment of choice being surgery be it through resections using strict guidelines (pneumonectomy, lobectomy, bi-lobectomy, segmentectomy). The resection is also recommended for patients with positive margins in stage I-II relapse, and if this were not possible, postoperative radiotherapy could be considered.

In the case described our patient presents 2 basal tumors right and left: poorly differentiated adenocarcinoma T3N0Mx and moderately differentiated adenocarcinoma T2bN0Mx, respectively, without evidence of ganglion affectation, being 2 synchronous bilateral tumors according to the currently used diagnostic criteria. Likewise, there was a delay in the performance of the total lower left lobectomy due to the patient's negation, bringing with it the local relapse to said level a1 initially treated incompletely (atypical left lower lobe resection), which is described in the literature, when faced with resections without strict guidelines the risk of local relapse increases.

Finally the current use of different aerostatic products help reduce postoperative air leaks and therefore reduce the hospital stay, as described in our case.

BIBLIOGRAPHY

1. **Soriano JB, Rojas-Rueda D, et al.** The burden of disease in Spain: Results from the Global Burden of Disease 2016. Med Clin (Barc). 2018 Sep 14;151(5):171-190. English, Spanish. doi: 10.1016/j.medcli.2018.05.011. Epub 2018 Jul 20. PMID: 30037695.
2. **Romaszko AM, Doboszyńska A.** Multiple primary lung cancer: A literature review. Adv Clin Exp Med. 2018 May;27(5):725-730. doi: 10.17219/acem/68631. PMID: 29790681.
3. **Martíni N, Malamed MR.** Multiple primary lung cancers. J Thorac Cardiovasc Surg 1975; 70: 606-612.
4. **Majem M, Juan O, Insa A, Reguart N, Trigo JM, Carcereny E, García-Campelo R, García Y, Guirado M, Provencio M.** SEOM clinical guidelines for the treatment of non-small cell lung cancer (2018). Clin Transl Oncol. 2019 Jan;21(1):3-17. doi: 10.1007/s12094-018-1978-1. Epub 2018 Nov 17. PMID: 30446985; PMCID: PMC6339680.

12

Use of TachoSil® in an arterial lesion avoiding the conversion to open surgery

Grando L, Quiroga N, Sanchez-Lorente D, Paglialunga P, Laureano Molins Lopez R, Boada M

Hospital Clínic de Barcelona

Introduction

In the habitual practice of thoracic surgery, one of the most feared intra-operative complications is the bleeding of arterial structures given that this implies a vital risk for the patient and is difficult to control through the access of the video thoracoscopy (VATS), with reconversion to open surgery being the immediate solution to repair the injured structure if doing so endoscopically is not possible. It has been registered that up to 9.3 %[1] of the patients that undergo video thoracoscopy require conversion to open surgery and of these, up to 30.4 %[1] is due to bleeding, being the most frequent cause of conversion of the anatomical variations and adhesions[2], considering this as a problem requiring constant revision in the specialty.

Hemostatic products are well known, many of them approved in our area for their utilization in active bleeding situations as considered by the surgeon and if they are accustomed to how and when to use them.

In the following case, the possibility of using certain tools is considered (such as products with determined characteristics) in order to avoid conversion to open surgery and reduce the comorbidity that this supposes for the patient.

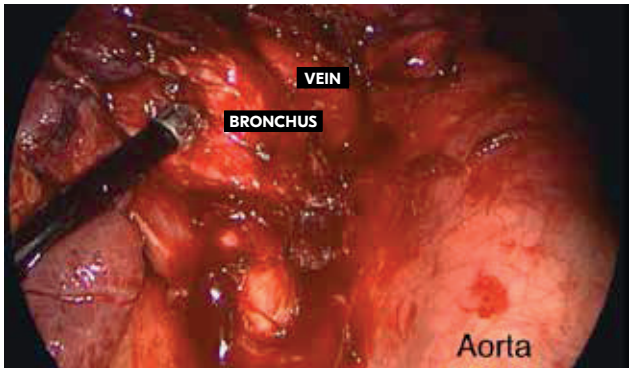


Image 1: Visualization of the aorta on the right, sectioned segmental vein on the left, next to the S6 bronchus. The aspirator is positioned directly above the rupture point of the artery where the sheet bleeding appears.

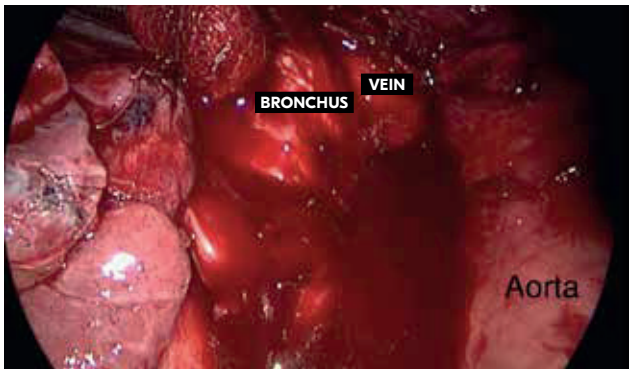


Image 2: The first maneuver performed which is the compression with a gauze swab, can be seen.

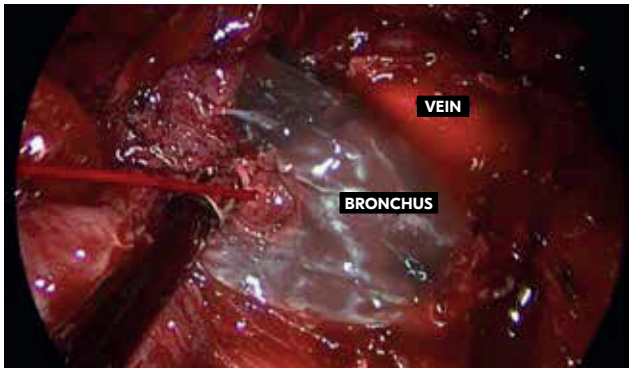


Image 3: After the first maneuver a jet bleed can be seen that originates from the segmental arteria hidden behind the bronchus.

Clinical case

A 77 year old male patient, with history of arterial hypertension, hyperthyroidism, peripheral vasculopathy in the form of intermittent claudication, monoclonal IgG-lambda gammopathy diagnosed in 2012 vesicular tumor treated with transurethral resection and prostatectomy in 2019.

In the context of admittance for community acquired pneumonia, a thoracic scan is performed where a pulmonary node in the left lower lobe (LLL) is observed, that has grown from 14 to 18 mm with respect to a scan from 8 months before captured in the PET with SUV mas of 4.7. After presentation to the multidisciplinary thoracic tumor committee it is decided to perform a therapeutic diagnostic surgery using anatomic segmentectomy of the apical segment of the lower left lobe.

During the surgical dissection of the bronchial branch of the apical segment of the LLL using VATS (3 ports), an incidental lesion is produced on one of the arterial branches (branch of the basal pyramid) *(→ Image 1)*. The first hemostatic intention is placing a dry gauze and compressing the structure *(→ Image 2)* during approximately 3 minutes.

In the verification, after removing the gauze, an arterial jet appears *(→ Image 3)*, and therefore they proceed to use the first hemostatic material made of oxidation controlled regenerated cellulose *(→ Image 4)*, not achieving hemostasis after compression of this during at least 5 minutes; the surgeon improves the exposure to the lesion through the bronchial section of the S6 with the Endo GIA stapler *(→ Image 5)*, controlling the bleeding with compression during the maneuver however when the compression is removed the jet persists *(→ Image 6)*.

They decide to place a second hemostatic adhesive matrix of human collagen, fibrinogen and thrombin (TachoSil®) *(→ Image 7)* maintaining pressure on it with gauze to keep it adhered to the arterial wall *(→ Image 8)*, achieving definitive hemostasis of the lesion in less than 2 minutes* *(→ Image 9)* permitting the surgery to continue by endoscopy and avoiding the thoracotomy with all of the posterior complications related to it.

* Manufacturer's recommendation: 3 minutes minimum compression

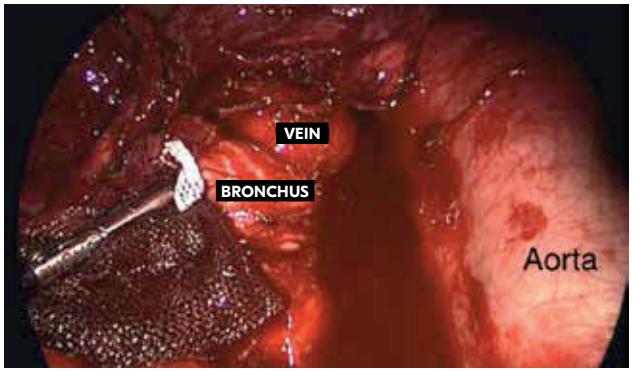


Image 4: A second maneuver using a hemostatic product (controlled oxidated regenerated cellulose material) is attempted.

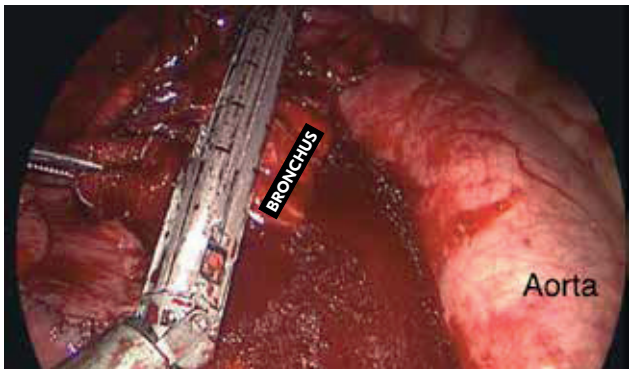


Image 5: To improve the exposure to the lesion a bronchial S6 section is performed.

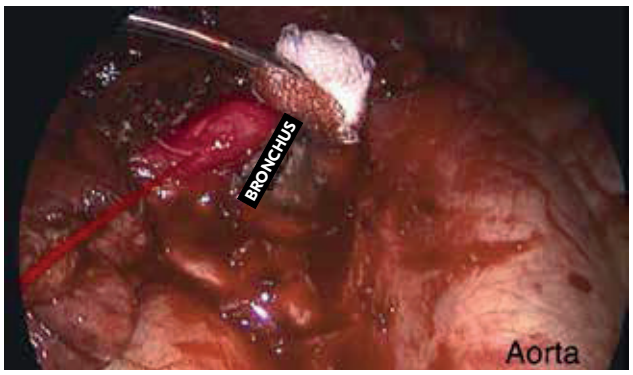


Image 6: Jet bleed persists but with improved exposure to the lesion, with the vein from behind and the bronchus section from below.

The patient is finally extubated in the operating room leaving the same with a pleural drain that shows no signs of acute bleeding in the immediate postoperative period, which is removed after 24 hours and being discharged with a control X-ray showing no images of pleural effusion or condensation.

Discussion

Video thoracoscopy is preferred over open surgery given its known advantages. Conversion is a risk factor in and of itself for the postoperative results, but in determined cases, the solution to a surgical accident of considerable magnitude is the conversion to open surgery for greater control of the structures[3].

The pre operative mortality is greater in the thoracotomy with respect to VATS, being 6.8 vs 0.2, respectively[2], the mortality at 5 years, 87 vs 70 %[4] and the ratio of complications (46 % vs 23 %)[5]. The cases in which interoperative complications are produced that obligate conversion to open surgery, for being unable to solve them via endoscopy, are associated with postoperative complications; for example, increase in the hospital stay, greater postoperative pain, longer time for thoracic drainage, the incidence of arrhythmias, principally auricular fibrillation, infection due to retaining secretions (atelectasis and pneumonias) and acute renal failure[1].

The existence of tools that allow us to solve these intra operative complications, without the need to convert to open surgery, suppose a reduction in the complications and improved post operative results.

In this particular case, the use of the hemostatic type TachoSil®, has proven to be effective for solving a jet arterial lesion that, in determined circumstances, would have been required conversion or amplification of the planned resection, in addition to solving it in a substantially shorter time than with other methods.

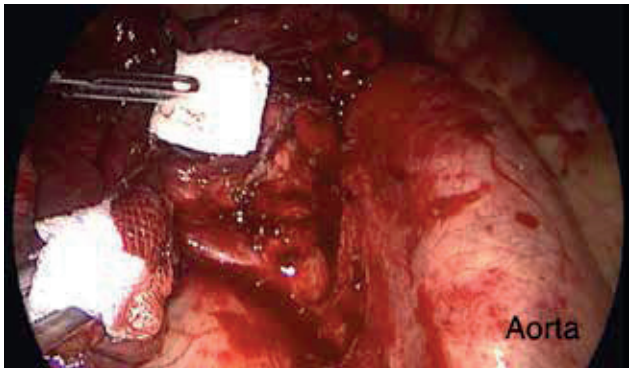


Image 7: TachoSil® is placed over the bleed.

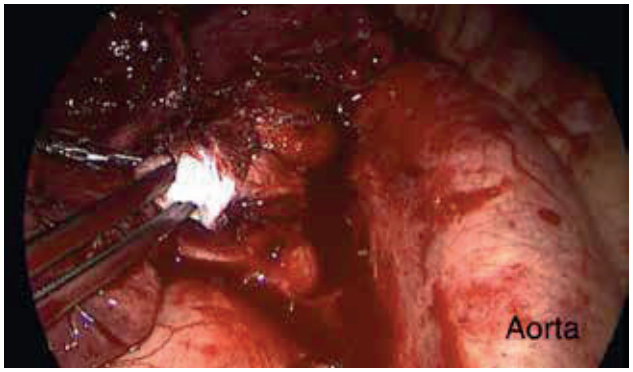


Image 8: Light pressure is sustained over the TachoSil® in order to initiate its action as a hemostatic adhered to the arterial wall.

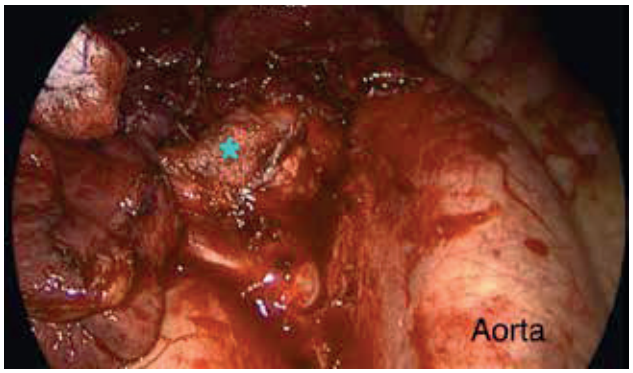


Image 9: The point where TachoSil®, marked with an (*) can be seen as well as the hemostasis achieved.

BIBLIOGRAPHY

1. **Bongiolatti S, Gonfiotti A, Viggiano D, Borgianni S, Politi L, Crisci R, Curcio C, Voltolini L, Italian VATS Group.** Risk factors and impact of conversion from VATS to open lobectomy: analysis from a national database. Surg Endosc. 2019 Dec;33(12):3953-3962. doi: 10.1007/s00464-019-06682-5. Epub 2019 Jan 31. Erratum in: Surg Endosc. 2019 Jun 4;: PMID: 30706153.
2. **Seitlinger J, Olland A, Guinard S, Massard G, Falcoz PE.** Conversion from video-assisted thoracic surgery (VATS) to thoracotomy during major lung resection: how does it affect perioperative outcomes? Interact Cardiovasc Thorac Surg. 2021 Jan 1;32(1):55-63. doi: 10.1093/icvts/ivaa220. PMID: 33236089; PMCID: PMC8906703.
3. **Fourdrain A, De Dominicis F, Iquille J, Lafitte S, Merlusca G, Witte-Pfister A, Meynier J, Bagan P, Berna P.** Intraoperative conversion during video-assisted thoracoscopy does not constitute a treatment failure†. Eur J Cardiothorac Surg. 2019 Apr 1;55(4):660-665. doi: 10.1093/ejcts/ezy343. PMID: 30325413.
4. **Gabryel P, Piwkowski C, Kasprzyk M, Zieliński P, Roszak M, Dyszkiewicz W.** Worse outcomes after conversion of thoracoscopic lobectomy for lung cancer. Interact Cardiovasc Thorac Surg. 2021 Apr 8;32(3):356-363. doi: 10.1093/icvts/ivaa274. PMID: 33221893; PMCID: PMC8906676.
5. **Puri V, Patel A, Majumder K, et al.** Intraoperative conversion from video-assisted thoracoscopic surgery lobectomy to open thoracotomy: a study of causes and implications. J Thorac Cardiovasc Surg. 2015;149(1):55-62.e1. doi:10.1016/j.jtcvs.2014.08.074

13

Application technique of TachoSil® using video thoracoscopy in pulmonary post lobectomy air leak

Congregado Loscertales M, Cózar Bernal F, Congregado González MM, Sánchez Rivera J, López Soltero R

Hospital Quirónsalud Infanta Luisa, Sevilla

Image 1: CAT with a tumor in the lower lobe of the right lung.

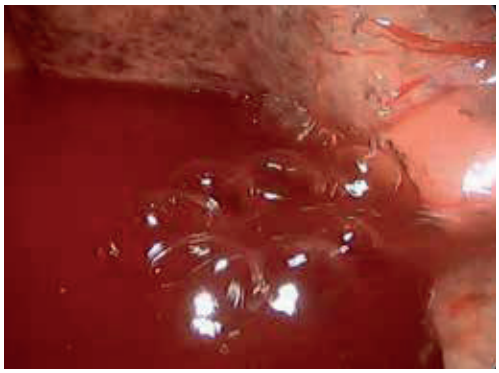


Image 2: Air leak after the lower right lobectomy, in the fissure grade 2 on the Macchiarini scale.

Introduction

Prolonged air leaks are one of the major problems after a pulmonary resection[1]. Today, it is the leading cause of extended post operative stay and the global cost of a pulmonary exeresis procedure[2]. In addition, they are also related to the need to maintain the pleural drainage for a longer period, with the associated pain problems and a greater risk of developing other complications such as respiratory infections atelectasis[3], etc.

To reduce the incidence of postoperative air leak many techniques and methods have been developed – such as:

- Use of a meticulous and clean surgical technique avoiding the manipulation and excessive pulling of the parenchyma areas that will not be removed.
- Technique that avoids the dissection of the cisura "Fissureless".
- Improved design of suture machines, such as the Endo GIA with tri-staple technology for suturing the pulmonary parenchyma.
- Use of sealants that guarantee a good seal of the sutures[4].

Image 3: Comparison of the size of the patch with the mini thoracotomy.

Image 4: Protection of the TachoSil® patch with the flap of its packaging.

Image 5: Holding the protective cover of the TachoSil® with two endoscopic clamps for its introduction to the mini thoracotomy.

Image 6: Introduction of the patch into the mini thoracotomy.

This last point has always been one of the desires of many thoracic surgeons that will be able to notably optimize their surgical results. But the problem doesn't generally reside in the sealing product in and of itself, since it has been demonstrated in many experimental studies in laboratories, that they have good adherence and resistance to very high pressure; the problem is that they are not used properly, be it for lack of patience of the surgeon, not correctly following the instructions, or due to difficulty in its application (for example the patches are much more complex to place by video thoracoscopy than in conventional open surgery).

The objective of this presentation, it to show that application technique of TachoSil® by video thoracoscopy is simple and reproducible, in case of the presence of an air leak post lobectomy.

Clinical case

Male patient of 81 years of age, pulmonary tumor affection of lower right lobe. Prior characteristics, is not allergic to known medications or sanitary products, ex-smoker with IPA of 45 packs/year, dyslipemia, intervened for an inguinal herniorrhaphy and treated with radiotherapy and hormonal block of prostate adenocarcinoma Gleason 7 (4 + 3). In addition and more interesting for this case, suffers from COPD type pulmonary emphysema with FEV1 of 68 % and DLCO of 61 %.

The localized tumor in the lower lobe of the right lung measured 55 x 38 x 85 mm, with irregular poorly defined borders, and was close to the major fissure *(→ Image 1)*. In PET/CAT it was proven to metabolically positive with SUV maximum of 11.9, without more ganglionic uptake or in any other location.

With this pre-operative study, and faced with a clinical stage cT3N0M0 (IIB) it was decided to submit the patient to a lower right lobectomy and mediastinal lymphadenectomy.

The operation was performed by video thoracoscopy through two entrance ports without incidents, although due to the proximity of the tumor, the dissection of the artery in the fissure was difficult. At the end of the operation, the saline test to verify the pneumostasis demonstrated that an air leak existed in the cisural zone, grade 2 on the Macciarini scale *(→ Image 2)*.

Image 7: Moving the TachoSil® patch through the pleural cavity to the location for application.

Image 8: Placement of the TachoSil® on the fissure.

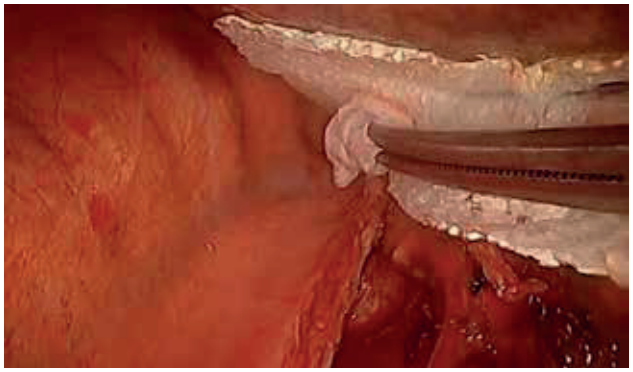


Image 9: Fastening the patch to the injured part of the pulmonary parenchyma with a moist gauze swab.

Image 10: Final appearance of the TachoSil® patch, perfectly adhered to the pulmonary surface,

Given the focalization of the leak, and its intensity, it was decided to place a TachoSil® patch to control the same.

As can be observed in Image 3, the problem is that the patch is much bigger than the mini-thoracotomy. For its introduction into the pleural cavity the flap of the cover of the same product package was used, protecting the TachoSil®. In this way adhesion to the would was avoided o during the trajectory of the same to the fissure, where itis to be placed *(→ Images 4, 5, 6, 7 and 8)*. Once in the desired location, TachoSil® is adhered to the injured surface of the pulmonary parenchyma, at half re-expansion, with a well moistened gauze swab on a long clamp, assuring the security of all of the borders and corners of the patch *(→ Image 9)*. Finally, in order to achieve good adherence of the product pressure is exerted maintaining the gauze dry, during 3 to 5 minutes reaching an optimum adherence of TachoSil® *(→ Image 10)*.

The result was very satisfactory, no air leak was seen, from the moment of extubation, and with complete pulmonary expansion without signs of pleuro-pulmonary complication. The drainage was removed at 48 hours and the patient was discharged from the hospital that same day.

Discussion

Finding the ideal product that obtain an optimum seal, and that void or at least reduce the air leaks after the pulmonary resection, is an objective of current thoracic surgery. It must be taken into consideration, that this product will be used in a challenging, complex situation, since the majority of the patients that undergo exeresis pulmonary surgery, are smoker, with chronic bronchitis and poor quality parenchyma. In addition, contrary to other organs in the human anatomy, the lung is an organ, that suffers many modifications during the ventilation process, changing size and levels of pressure; a very dynamic tissue that increases the challenges of any type of sealant[5].

From this point of view, for the thoracic surgeon, the ideal sealing product is that which has the following characteristics:

- Simple preparation.
- Easy to apply.
- Strong and rapid adherence.
- Have sufficient elasticity.
- Non-toxic.
- Biodegradable.
- Economical.

Just as we have shown in this case presentation TachoSil® complies with these criteria with notable sufficiency. It is simple to prepare, just open the package and it is ready to use. It has strong adherence, since it can tolerate pressure of up to 60 Hp[6]. Although when it is dry it is rigid and can break, when the matrix is moistened the collagen with its hexagonal disposition like a bee honeycomb, makes it very elastic and moldable. It is non-toxic and biodegradable, and compared to other products on the market it is economical With respect to its ease of application, its use in open surgery is not under discussion, since it is very simple and comfortable to use, but it is true that there is not a unanimous consensus regarding its application by video thoracoscopy. It is felt, that in a minimally invasive surgery it is complicated to place it in the exact spot where it is to be applied, since the product can adhere along the way and then it is more complex to exercise the pressure in the adequate form in this area during the time necessary to obtain optimal adherence.

With the presentation of this case and the proposed application technique, we think we can refute this idea, and show that the application of TachoSil® using video thoracoscopy is very simple and if used correctly, prevents and avoids air leaks in a very effective way.

BIBLIOGRAPHY

1. **Ziarnik E, Grogan E.** Postlobectomy early complications. Thorac Surg Clin 2015; 25:355-364. http://dx.doi.org/10.1016/j.thorsurg.2015.04.003.
2. **Varela G, Jiménez MF, Novoa N, Aranda JL.** Estimating hospital costs attributable to prolonged air leak in pulmonary lobectomy. Eur J Cardiothorac Surg. 2005 Feb;27(2):329-33. doi: 10.1016/j.ejcts.2004.11.005. PMID: 15691691.
3. **Zheng Q, Ge L, Zhou J, Zhang Y, Lyu M, Chen C, et al.** Risk factors for prolonged air leak after pulmonary surgery: A systematic review and meta-analysis, Asian Journal of Surgery, https://doi.org/10.1016/j.asjsur.2022.01.001.
4. **Marta GM, Facciolo F, Ladegaard L, Dienermann H, Csekeo A, Rea F, et al.** Efficacy and safety of TachoSil versus standard treatment of air leakage after pulmonary lobectomy. Eur J Cardio-thorac Surg 2010;38:683-690.
5. **Mier JM, Molins L, Fibla JJ.** The benefits of digital air leak assessment after pulmonary resection: Prospective and comparative study. Cir Esp 2010;87:385-389.
6. **Carbon RT, et al.** Tissue Management with Fleece-Bound Sealing, 6th World Congress on Trauma, Shock, Inflammation and Sepsis, Medimond S.r.l, Munich, Germany, March 2004, p. 263-64

TachoSil® — four versions, three sizes*

TachoSil SEALANT MATRIX

Illustrated in original size

*Not all versions are available in all countries

TachoSil Sealant Matrix
(5.5 mg per cm² of human fibrinogen, 2.0 IU per cm² of human thrombin)

Statement: Before prescribing, consult/refer to the full prescribing information. **Presentation:** An off-white sealant matrix. The active side of the matrix is coated with fibrinogen and thrombin, is marked by a yellow colour. Supplied, ready to use, in sterile packaging. **Legal Classification:** Restricted prescription only medicine. **Indications:** In adults and children from 1 month old, for supportive treatment in surgery for improvement of haemostasis, to promote tissue sealing, and for suture support in vascular surgery where standard techniques are insufficient; also, in adults for supportive sealing of the dura mater to prevent postoperative cerebrospinal leakage following neurosurgical procedures. **Dosage & Administration:** For epilesional use only. Use is restricted to experienced surgeons. The quantity to be applied is governed by the size of wound area, and the underlying clinical need for the patient. In clinical studies, the individual dosages have typically ranged from 1-3 units (9.5 cm x 4.8 cm); application of up to 10 units has been reported. For smaller wounds, the smaller size matrices (4.8 cm x 4.8 cm or 3.0 cm x 2.5 cm) or the pre-rolled matrix (based on a matrix of 4.8 cm x 4.8 cm) is recommended. TachoSil should be used under sterile conditions and immediately after opening the inner sterile cover. Prior to application, the wound area should be cleansed, e.g. from blood, disinfectants and other fluids. For Flat TachoSil, the sterile package should be pre-moistened in saline solution and applied immediately. The yellow, active side of the matrix is applied to the bleeding/leaking surface and held against it with a gentle pressure for 3-5 minutes. For pre-rolled TachoSil, after removing from the sterile package, it should be applied immediately through the trocar without pre-moistening. The yellow, active side of the matrix is applied to the bleeding/leaking surface using e.g., a pair of cleansed forceps and held against it with a moist pad under gentle pressure for 3-5 minutes. Pressure is applied with moistened gloves or a moist pad. Avoid TachoSil sticking to surgical instruments, gloves or adjacent tissues covered with blood by cleansing them before application. After pressing TachoSil to the wound, the glove or the pad must be removed carefully. To avoid TachoSil from being pulled loose it may be held in place at one end, e.g. with a pair of forceps. In the case of stronger bleeding, it may be applied without pre-moistening, while also pressing gently to the wound for 3-5 minutes. The active side of TachoSil should be applied so that it extends 1-2 cm beyond the margins of the wound. If more than one matrix is used, they should overlap. TachoSil can be cut to the correct size and shaped if too large. In neurosurgery, TachoSil should be applied on top of the primary dura closure. **Contraindications:** Intravascular use; hypersensitivity to the active substances or to any of the excipients. **Warnings & Precautions:** No specific data available on the use of this product in gastrointestinal anastomoses surgery. Life threatening thromboembolic complications may occur if the preparation is applied intravascularly. Allergic type hypersensitivity reactions are possible, as with any protein product. If hypersensitivity reactions occur, the administration must be discontinued immediately. To prevent the development of tissue adhesions at undesired sites, ensure tissue areas outside the desired application area are adequately cleansed before administration. In the case of shock, the current medical standards for shock treatment should be followed. Standard measures to prevent infections resulting from the use of medicinal products prepared from human blood or plasma include selection of donors, screening of individual donations and plasma pools for specific markers of infection and the inclusion of effective manufacturing steps for the inactivation/removal of viruses. Measures taken are considered effective for enveloped viruses such as HIV, HBV and HCV and for the non-enveloped virus HAV. Measures may be of limited value against non-enveloped viruses such as parvovirus B19. Parvovirus B19 infection may be serious for pregnant women (foetal infection) and for individuals with immunodeficiency or increased erythropoiesis (e.g., haemolytic anaemia). It is recommended to record the name and the batch number of the product administered to the patient. Some cases of product non-adhesion issues have been reported in the form of lack of product adhesion / lack of efficacy. Correct product handling and application is required **Interactions:** No interaction studies have been performed. Similar to comparable products or thrombin solutions, the sealant may be denatured after exposure to solutions containing alcohol, iodine, or heavy metals. Such substances should be removed to the greatest possible extent before applying the sealant. **Fertility, Pregnancy & Lactation:** Safety for use in human pregnancy or breastfeeding has not been established in the clinical studies. Only administer to pregnant and breastfeeding women if clearly needed. **Effects on Ability to Drive and Use Machines:** Not relevant. **Undesirable Effects:** Hypersensitivity or allergic reactions (in isolated cases these reactions may progress to severe anaphylaxis; some cases of product residue causing granuloma), thromboembolic complications may occur if used intravascularly, and adhesions and intestinal obstruction when used in abdominal surgery. Refer to the SmPC for details on full side effect profile and interactions. **Overdose information:** No case of overdose has been reported. **Interactions with Other Medicinal Products:** No interaction studies have been performed. Similar to comparable products or thrombin solutions, the sealant may be denatured after exposure to solutions containing alcohol, iodine or heavy metals (e.g., antiseptic solutions). Such substances should be removed to the greatest possible extent before applying the sealant. **Use in Special Populations:** Limited data are available to support efficacy and safety of TachoSil in the paediatric population. In clinical studies, a total of 36 paediatric patients aged 0-13 years were treated with TachoSil in hepatic surgery. **Pack Sizes:** Package with 1 matrix of 9.5 cm x 4.8 cm, Package with 2 matrices of 4.8 cm x 4.8 cm, Package with 1 matrix of 3.0 cm x 2.5 cm, Package with 5 matrices of 3.0 cm x 2.5 cm, Package with 1 pre-rolled matrix of 4.8 cm x 4.8 cm. Not all pack sizes may be marketed.

Marketing Authorisation Holder: Corza Medical GmbH,
Speditionstraße 21, 40221 Düsseldorf, Germany
The full SmPC can be obtained from Corza Medical GmbH.
Marketing Authorisation Numbers: EU/1/04/277/001-005

Date of Revision of the Text: 8 May 2025
Link to Full SmPC or Prescribing information

www.corza.com

corzamedical