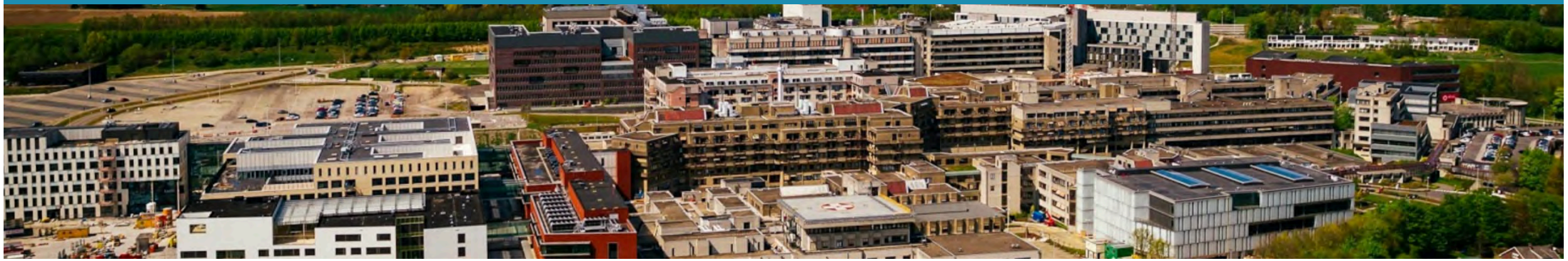
# Surgical Anatomy of the Lung
# &
# VATS anatomical resections

herbert.decaluwe@uzleuven.be



# Objective

To understand and master:

- Basic Surgical Anatomy of the Lung
- Lymph Node Map
- Procedural steps in the resection of:
  - All 5 lobes
  - Most common segmentectomies
- Common issues leading to major complications
- ERP ‘Enhanced Recovery Program’

# Literature

Surgical Technique



## Video-assisted thoracic surgery tunnel technique: an alternative fissureless approach for anatomical lung resections

Herbert Decaluwé

Department of Thoracic Surgery, Leuven University Hospitals, Leuven, Belgium
*Correspondence to:* Herbert Decaluwé. Department of Thoracic Surgery, University Hospitals Leuven, Herestraat 49, 3000 Leuven, Belgium.
Email: Herbert.decaluwe@uzleuven.be.

**Abstract:** We describe an alternative video-assisted thoracic surgery (VATS) fissureless pulmonary lobectomy technique. This involves opening the fissure completely and with staplers at an early stage of the procedure by making a tunnel between the bronchovascular structures and the lung parenchyma. To minimize air leak after anatomical lung resections, many surgeons use a "fissureless" VATS technique, using staplers to divide the hilar bronchovascular structures first and the main part of the parenchyma in the fissure last. Others try to find the artery by dissecting the parenchyma in the fissure. The advantage of the latter is clearance of N1 nodes and anatomical overview prior to division of bronchovascular structures. But, airleak can be induced when touching the parenchyma. The proposed alternative procedure tries to combine the advantages of both common techniques, i.e., reduce risk of airleak and obtain a good anatomical overview and N1 nodal clearance prior to division of the bronchovascular structures. To open the incomplete fissure first, with staplers, a tunnel dissection is started anterior between the triangle of pulmonary veins and the parenchyma. After identification of the pulmonary artery (PA), the anvil of a first stapler is placed on top of the artery and the anterior part of the fissure is divided. Dissection between artery and parenchyma is continued until the fissure is completely stapled. By making a tunnel between the bronchovascular structures and parenchyma from anteriorly to posteriorly, one can open the fissure completely with staplers at an early stage of an anatomical lung resection. This combines the advantages of both the "fissureless" hilum first technique and classic (open) fissure first dissection, i.e., minimal air leak and optimal anatomical overview before bronchovascular structures are divided, potentially avoiding inadvertent transections.

**Keywords:** Video-assisted thoracic surgery (VATS); lobectomy; fissure; fissureless; air leak; stapler

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### Introduction

During lung surgery, surgeons use mechanical staplers on the fissural parenchyma between different lobes to minimize the chance of postoperative prolonged airleak. Many video-assisted thoracic surgery (VATS) surgeons use a "hilum first, fissure last technique". The hilar bronchovascular structures are divided first and during the last step of the lobectomy the lobe is lifted and the fissural parenchyma is divided. Thanks to these fissureless techniques, incomplete or fused fissures are no longer contraindications for VATS anatomical resections (1,2).

Some VATS surgeons and many robotic surgeons continue to reveal the artery by dissecting into the fissural parenchyma. This technique, similar to open surgery, allows surgeons to remove N1 nodes on the artery and bronchus first, and to look for anatomical variations before starting to divide the bronchovascular structures. But, dissecting into the incomplete fissure can cause prolonged airleak.

The objective of this paper is to present an alternative fissureless technique, combining the advantages of the techniques described above.

### Methods

#### *Technique*

#### General principles

The objective of the presented technique is to open





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ORIGINAL ARTICLE

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## Major intraoperative complications during video-assisted thoracoscopic anatomical lung resections: an intention-to-treat analysis†

Herbert Decaluwe[a,b,*], René Horsleben Petersen[c], Henrik Hansen[c], Cezary Piwkowski[d], Florian Augustin[e], Alessandro Brunelli[f], Thomas Schmid[g], Kostas Papagiannopoulos[f], Johnny Moons[a,b] and Dominique Gossot[h], on behalf of the ESTS Minimally Invasive Thoracic Surgery Interest Group (MITIG)

[a] Department of Thoracic Surgery, University Hospitals Leuven, Leuven, Belgium
[b] Department of Clinical and Experimental Medicine, KU Leuven, Leuven, Belgium
[c] Department of Cardiothoracic Surgery, Copenhagen University Hospital Rigshospitalet, Copenhagen, Denmark
[d] Department of Thoracic Surgery, Karol Marcinkowski University, Poznan, Poland
[e] Department of Thoracic Surgery, Innsbruck Medical University, Innsbruck, Austria
[f] Department of Thoracic Surgery, St James's University Hospital, Leeds, UK
[g] Department of Thoracic Surgery, Institut Mutualiste Montsouris, Paris, France

* Corresponding author. Herestraat 49, Leuven 3000, Belgium. Tel: +32-16-346820; fax: +32-16-346821; e-mail: herbert.decaluwe@uzleuven.be (H. Decaluwé).

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### Abstract

**OBJECTIVES:** A multicentre evaluation of the frequency and nature of major intraoperative complications during video-assisted thoracoscopic (VATS) anatomical resections.

**METHODS:** Six European centres submitted their series of consecutive anatomical lung resections with the intention to treat by VATS. Conversions to thoracotomy, vascular injuries and major intraoperative complications were studied in relation to surgeons' experience. Major complications included immediate life-threatening complications (i.e. blood loss of more than 2 l), injury to proximal airway or other organs or those leading to unplanned additional anatomical resections. All cases were discussed by a panel and recommendations were drafted.

**RESULTS:** A total of 3076 patients were registered. Most resections (90%, *n* = 2763) were performed for bronchial carcinoma. There were 3 intraoperative deaths, including 1 after conversion for technical reasons. In-hospital mortality was 1.4% (*n* = 43). Conversion to open thoracotomy was observed in 5.5% (*n* = 170), of which 21.8% (*n* = 37) were for oncological reasons. 29.4% (*n* = 50) for technical reasons and 48.8% (*n* = 83) for complications. Vascular injuries were reported in 2.9% (*n* = 88) patients and led to conversion in 2.2% (*n* = 70). In 1.5% (*n* = 46), major intraoperative complications were identified. These consisted of erroneous transection of bronchovascular structures (*n* = 9); injuries to gastrointestinal organs (*n* = 5) or proximal airway (*n* = 6); complications requiring additional unplanned major surgery (*n* = 9) or immediate life-threatening complications (*n* = 17). Twenty-three percent of the in-hospital mortalities (*n* = 10/43) were related to major intraoperative complications. Eight pneumonectomies (five intraoperative and three postoperative at 0.3%) were a consequence of a major complication. Surgeon's experience was related to non-oncological conversions, but not to vascular injuries or major complications in a multivariable logistic regression analysis.

**CONCLUSION:** Major intraoperative complications during VATS anatomical lung resections are infrequent, seem not to be related to surgical experience but have an important impact on patient outcome. Constant awareness and a structured plan of action are of paramount importance to prevent them.

**Keywords:** VATS • Lobectomy • Complication • Conversion • Experience • Lung cancer

### INTRODUCTION

Minimally invasive surgery for anatomical lung resections is unevenly utilized among European Thoracic Services. It is only in dedicated centres that the majority of lobectomies are performed by video-assisted thoracoscopic surgery (VATS) [1]. These comprised ~25% of the voluntary European Society of Thoracic Surgeons (ESTS) database in 2013, but a clear rise in the use of VATS has been observed over recent years [2]. A further increase is to be expected as analysis of large databases shows fewer perioperative

†Presented at the 23rd European Conference on General Thoracic Surgery, Lisbon, Portugal, 31 May–3 June 2015.



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GUIDELINES

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## Guidelines for enhanced recovery after lung surgery: recommendations of the Enhanced Recovery After Surgery (ERAS®) Society and the European Society of Thoracic Surgeons (ESTS)

Timothy J.P. Batchelor[a,*], Neil J. Rasburn[b], Etienne Abdelnour-Berchtold[c], Alessandro Brunelli[d], Robert J. Cerfolio[e], Michel Gonzalez[c], Olle Ljungqvist[f], René H. Petersen[g], Wanda M. Popescu[h], Peter D. Slinger[i] and Babu Naidu[j]

[a] Department of Thoracic Surgery, University Hospitals Bristol NHS Foundation Trust, Bristol, UK
[b] Department of Anaesthesia, University Hospitals Bristol NHS Foundation Trust, Bristol, UK
[c] Division of Thoracic Surgery, Centre Hospitalier Universitaire Vaudois, Lausanne, Switzerland
[d] Department of Thoracic Surgery, St. James's University Hospital, Leeds, UK
[e] Department of Cardiothoracic Surgery, New York University Langone Health, New York, NY, USA
[f] Department of Surgery, Faculty of Medicine and Health, Örebro University, Örebro, Sweden
[g] Department of Thoracic Surgery, Rigshospitalet, University of Copenhagen, Copenhagen, Denmark
[h] Department of Anesthesiology, Yale University School of Medicine, New Haven, CT, USA
[i] Department of Anesthesia, University Health Network - Toronto General Hospital, Toronto, ON, Canada
[j] Department of Thoracic Surgery, Heart of England NHS Foundation Trust, Birmingham, UK

* Corresponding author. Department of Thoracic Surgery, Bristol Royal Infirmary, Upper Maudlin Street, Bristol BS2 8HW, UK. Tel: +44-117-3423132; e-mail: tim.batchelor@uhbristol.nhs.uk (T.J.P. Batchelor).

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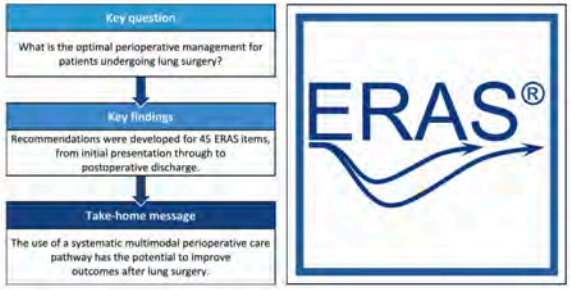
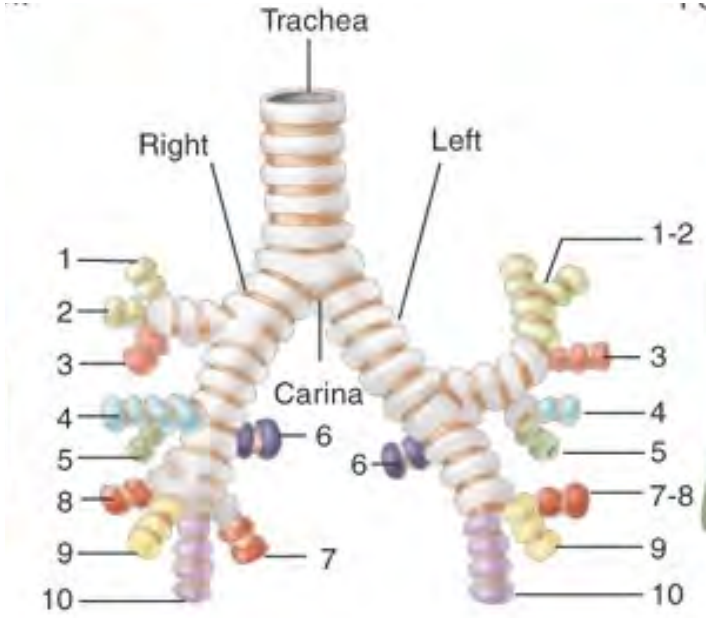
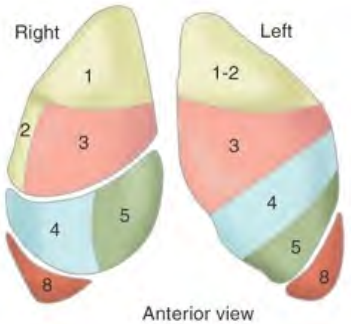


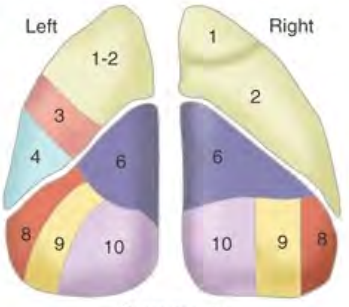
# Basic Surgical Anatomy of the Lung




| | | | |
|---|---|---|---|
| Upper lobe | 1. Apical | 1-2. Apical-posterior | Upper lobe |
| | 2. Posterior | | |
| | 3. Anterior | 3. Anterior | |
| Middle lobe | 4. Lateral | 4. Superior | Lingula |
| | 5. Medial | 5. Inferior | |
| Lower lobe | 6. Superior | 6. Superior | Lower lobe |
| | 7. Med. basal | 7-8. Ant. basal | |
| | 8. Lat. basal | 9. Lat. basal | |
| | 9. Lat. basal | 10. Post. basal | |
| | 10. Post. basal | | |

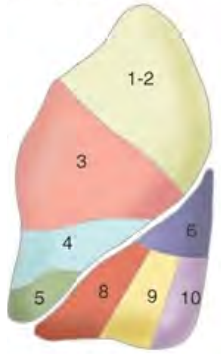


Anterior view

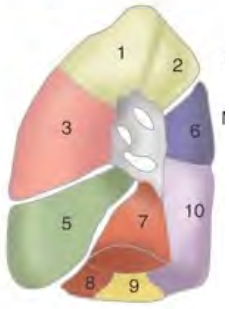


Posterior view

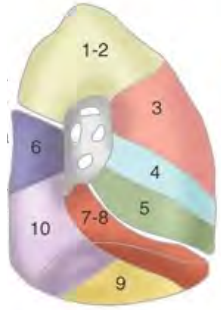
Right lateral view



Left lateral view



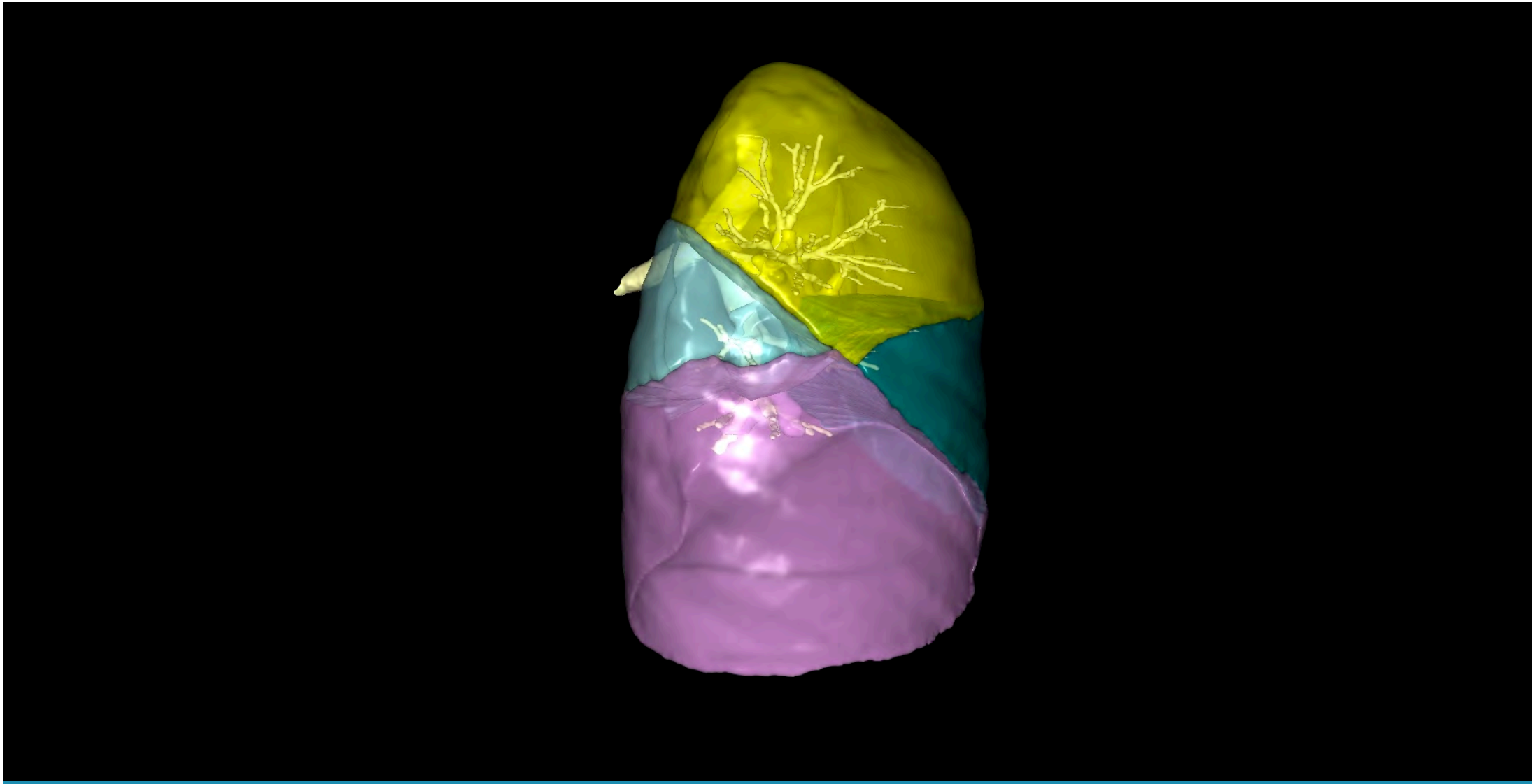
Right medial view

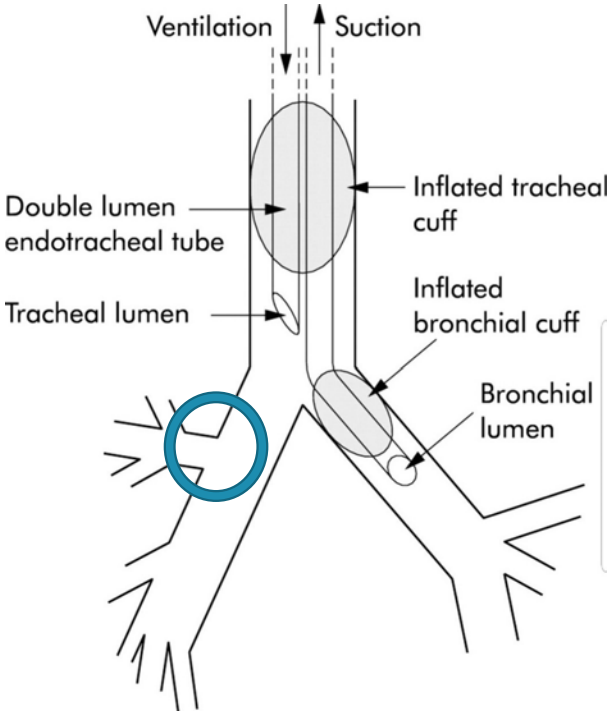


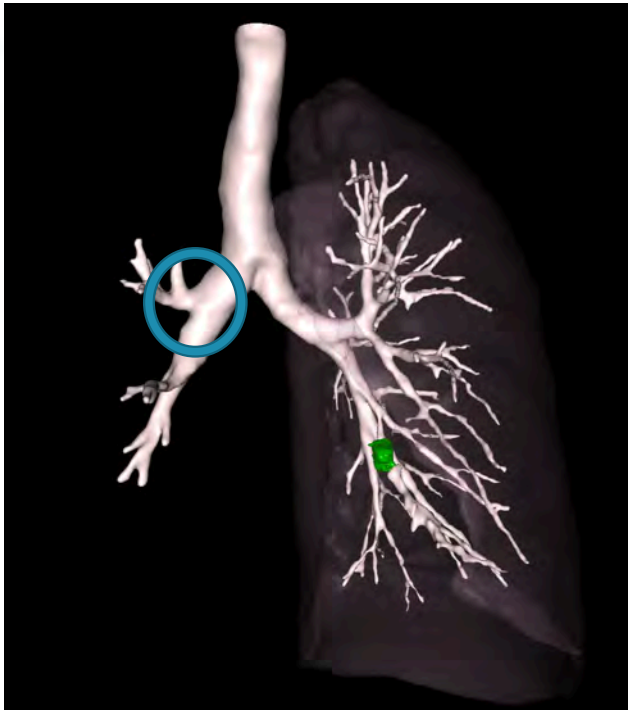
Left medial view

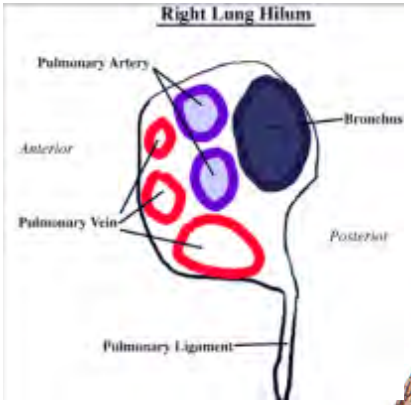
| | Right | | | | | Left | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Nr | Segments | Right | Bronchus | | Artery | Segments | Bronchus | | | Artery |
| 1 | apical | Upper Lobe | Upper Lobe Bronchus | B1 | A1 | apicoposterior (1+2) | Upper Lobe | Culmen | B1+2 | A1 |
| 2 | posterior | | | B2 | A2 Posterior Ascending | | | | | A2 |
| 3 | anterior | | | B3 | A3 | anterior | | | B3 | A3 |
| 4 | medial | Middle Lobe | Middle Lobe Bronchus | | One or two Middle lobe arteries | superior | | Lingula | Lingular Bronchus | Lingula Artery |
| 5 | lateral | | | | | inferior | | | | |
| 6 | apical | Lower Lobe | Lower Lobe Bronchus | B6 | A6 | apical | Lower Lobe | | B6 | A6 |
| 7 | medial basal | | | Basal Segments | Basal Segments | antero medial basal (8) | | | Basal Segments | Basal Segments |
| 8 | anterior basal | | | | | | | | | |
| 9 | lateral basal | | | | | lateral basal | | | | |
| 10 | posterior basal | | | | | posterior basal | | | | |

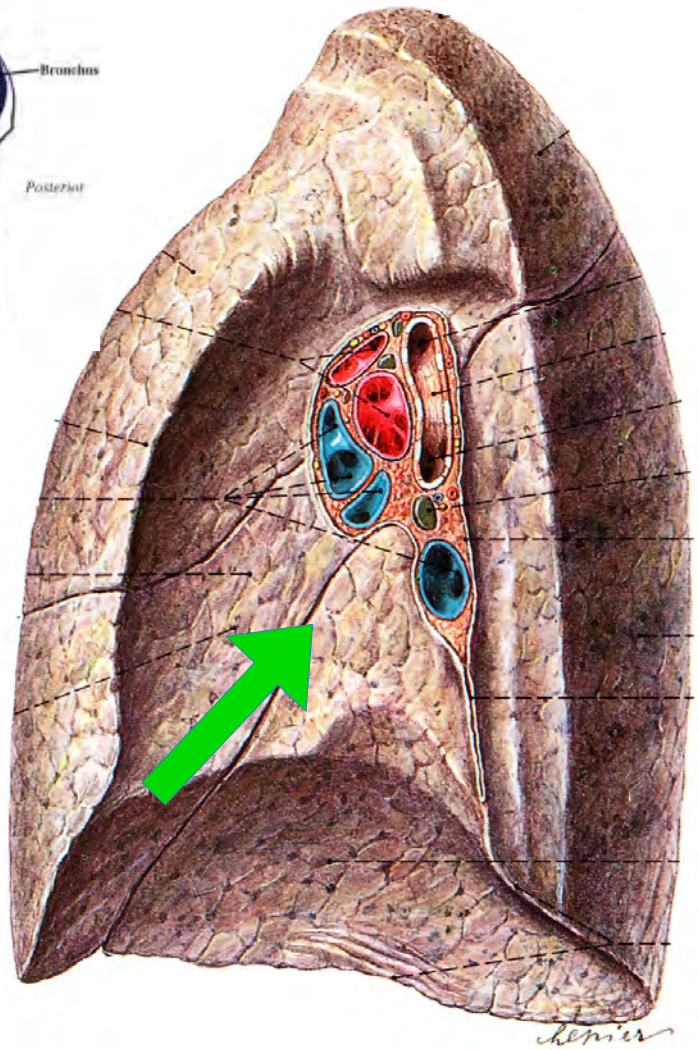
# Bronchial Anatomy

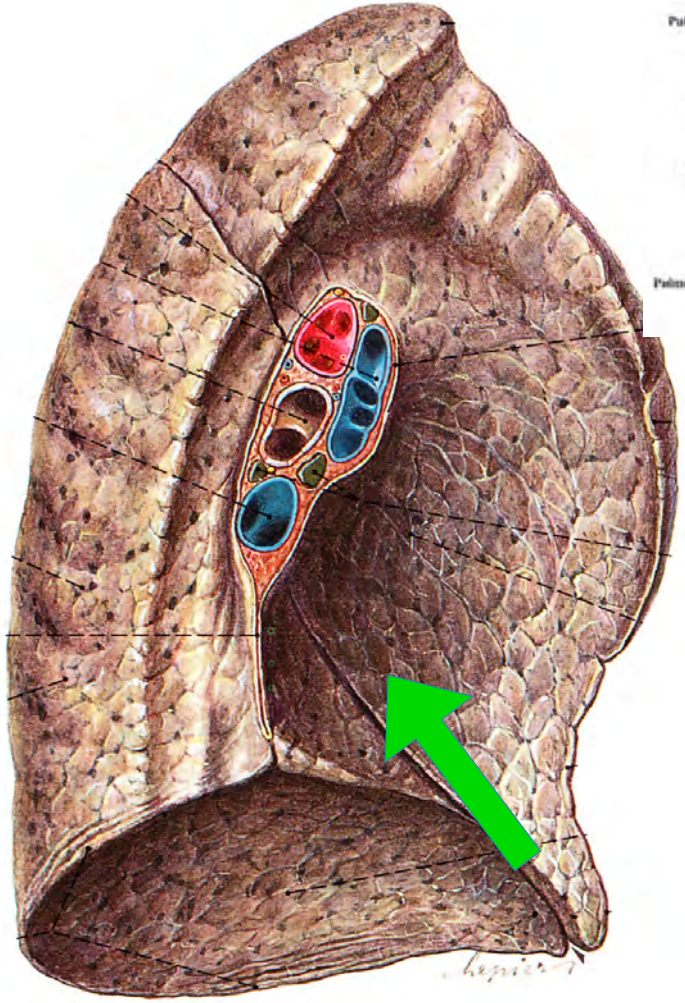


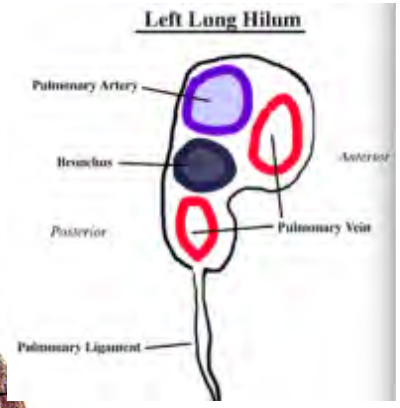

Ventilation
Suction
Double lumen endotracheal tube
Inflated tracheal cuff
Tracheal lumen
Inflated bronchial cuff
Bronchial lumen

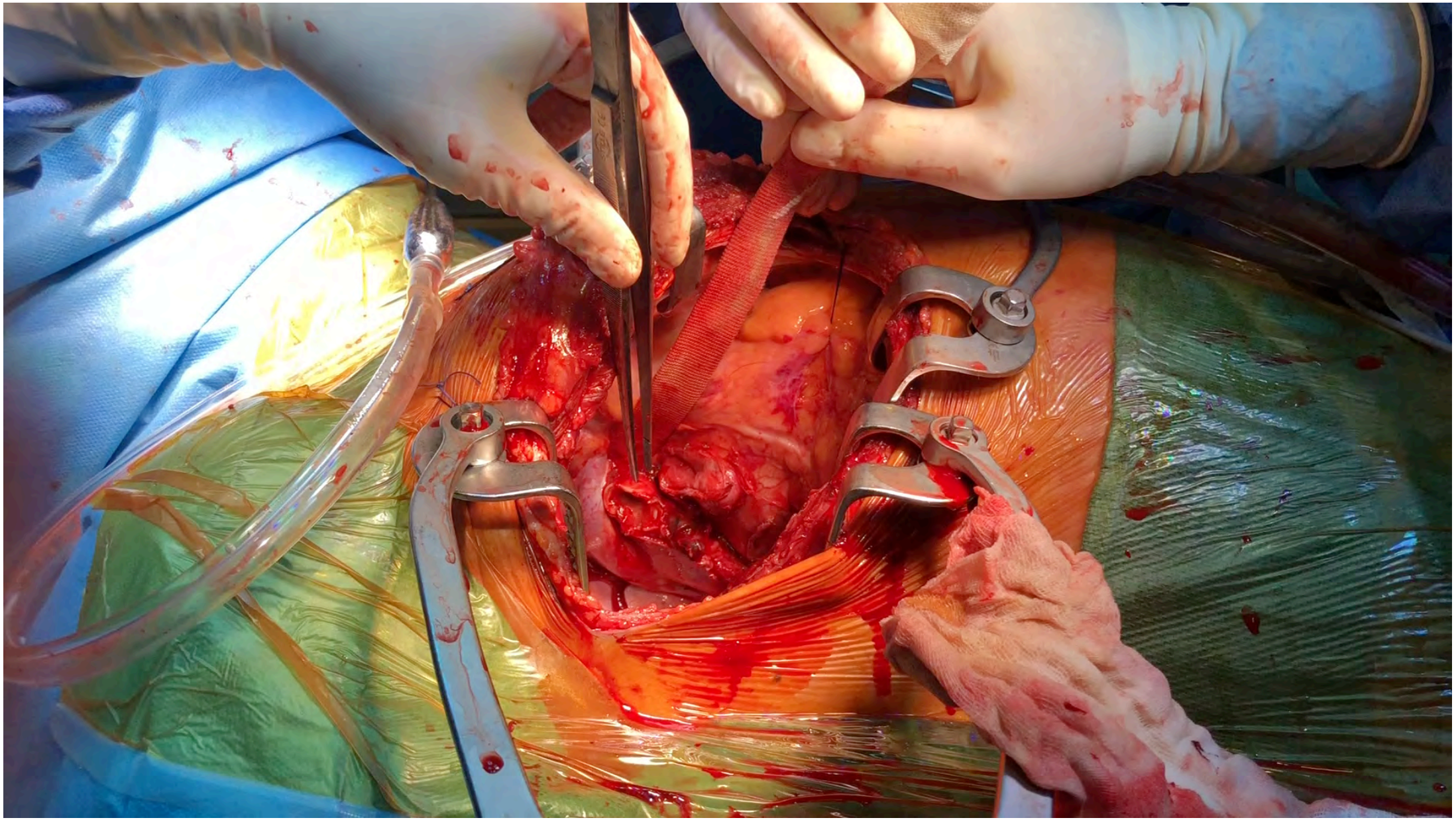



Right Lung Hilum
Pulmonary Artery
Bronchus
Anterior
Pulmonary Vein
Posterior
Pulmonary Ligament

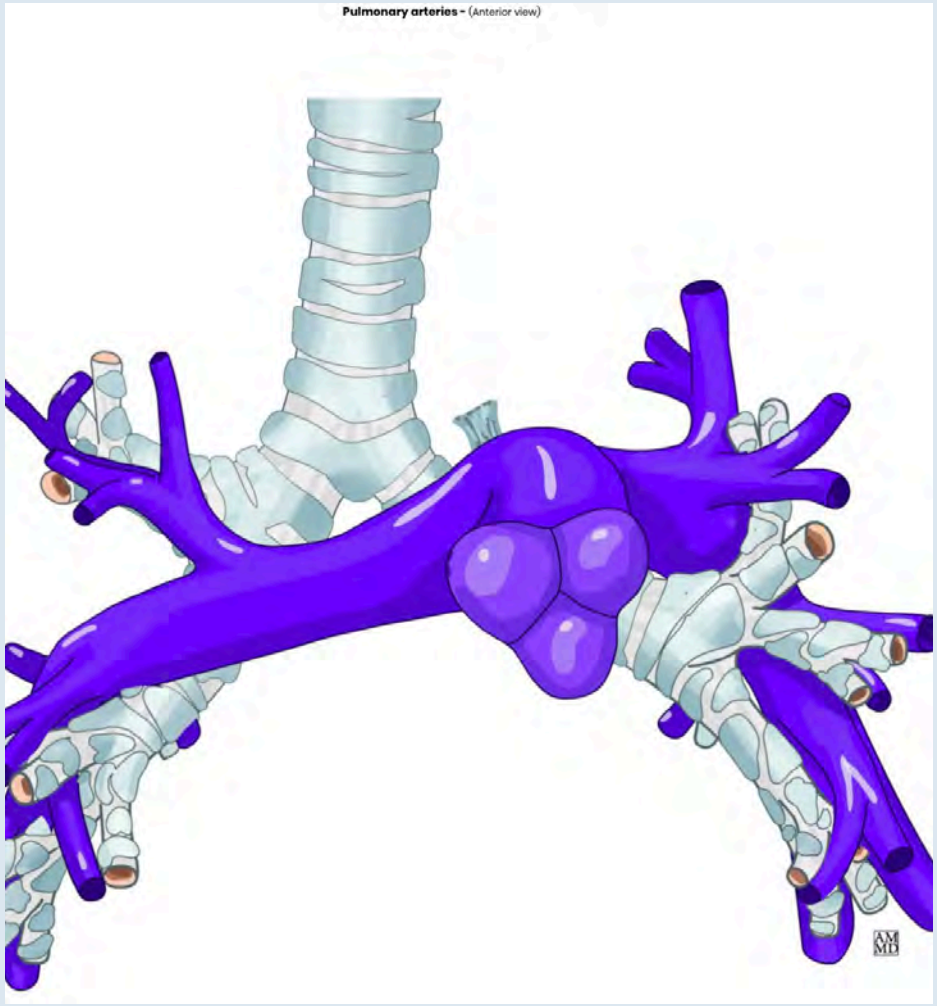


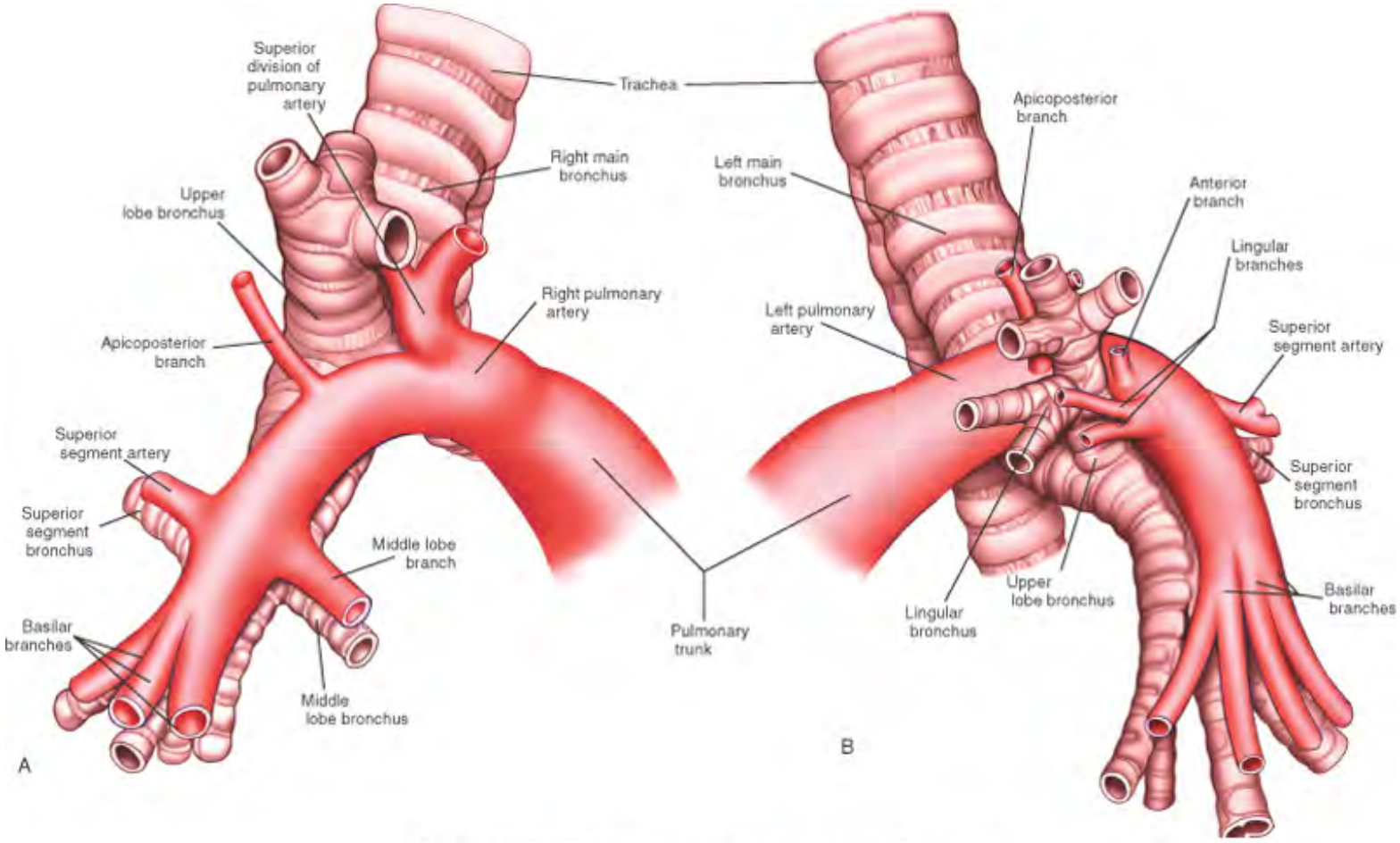


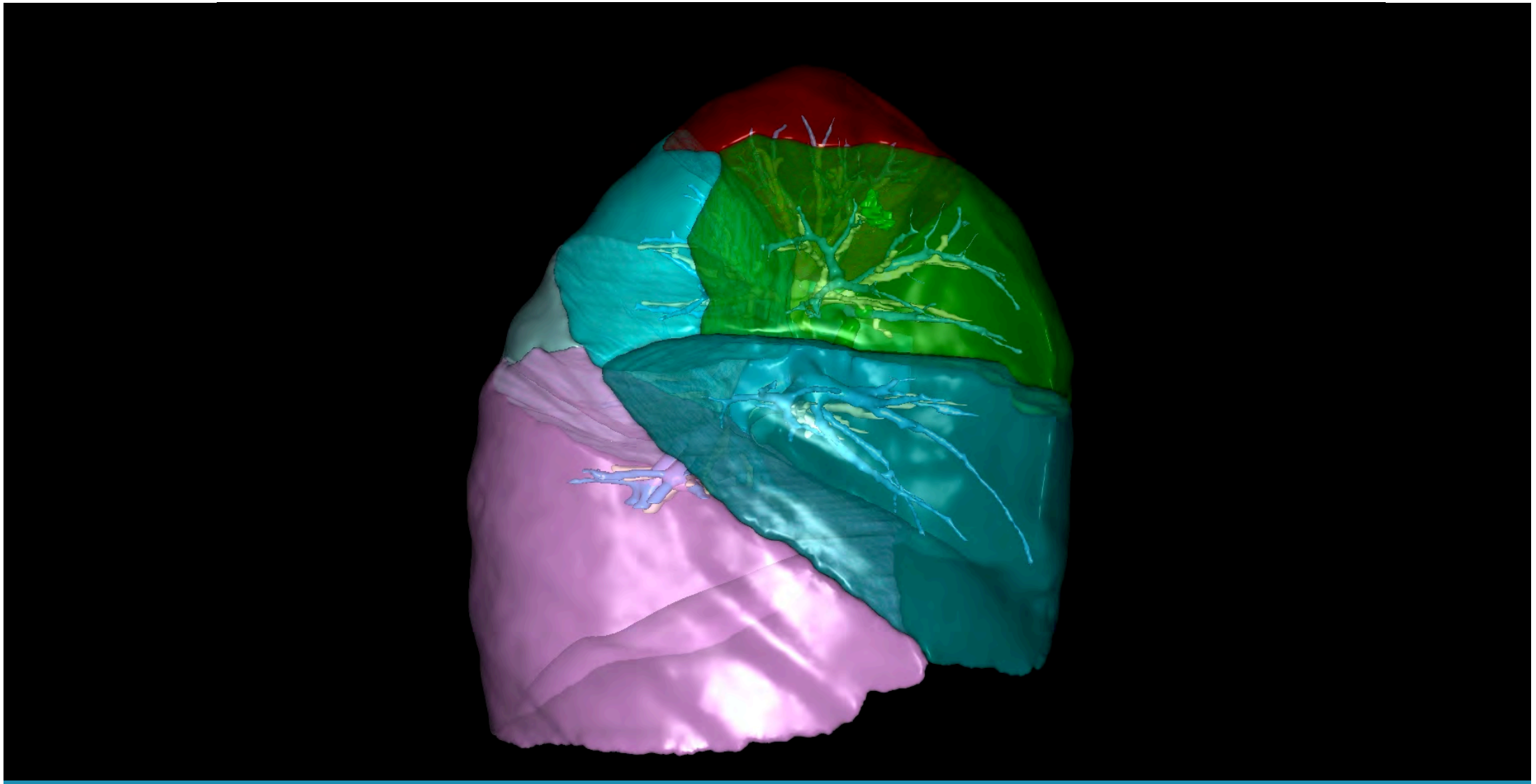

Left Lung Hilum
Pulmonary Artery
Bronchus
Anterior
Posterior
Pulmonary Vein
Pulmonary Ligament

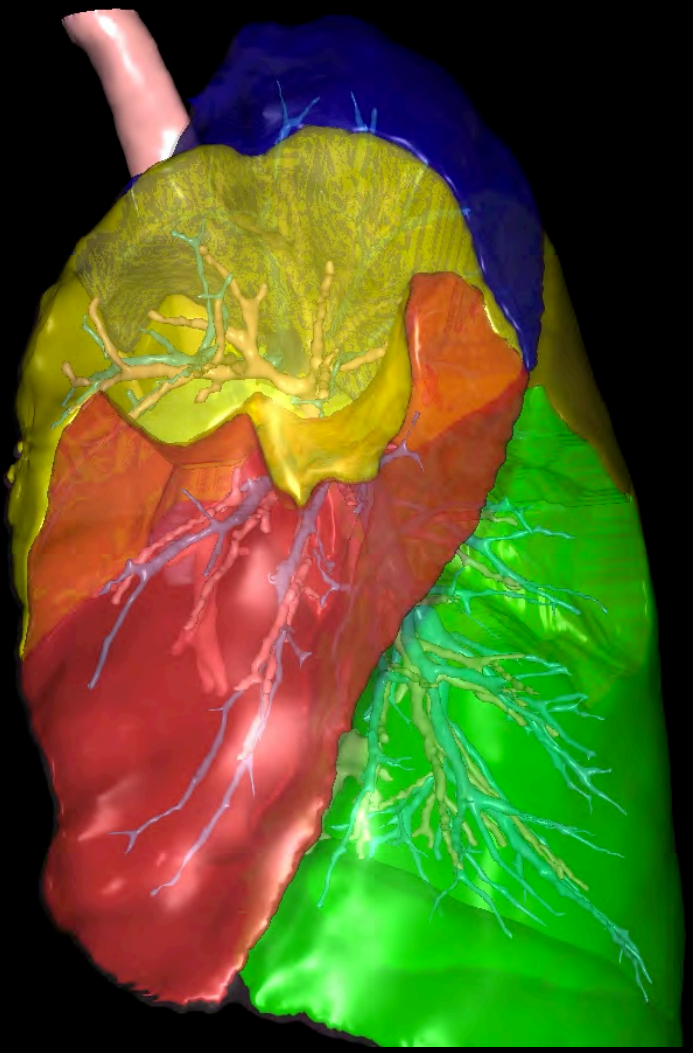


# Bronchus and pulmonary Artery

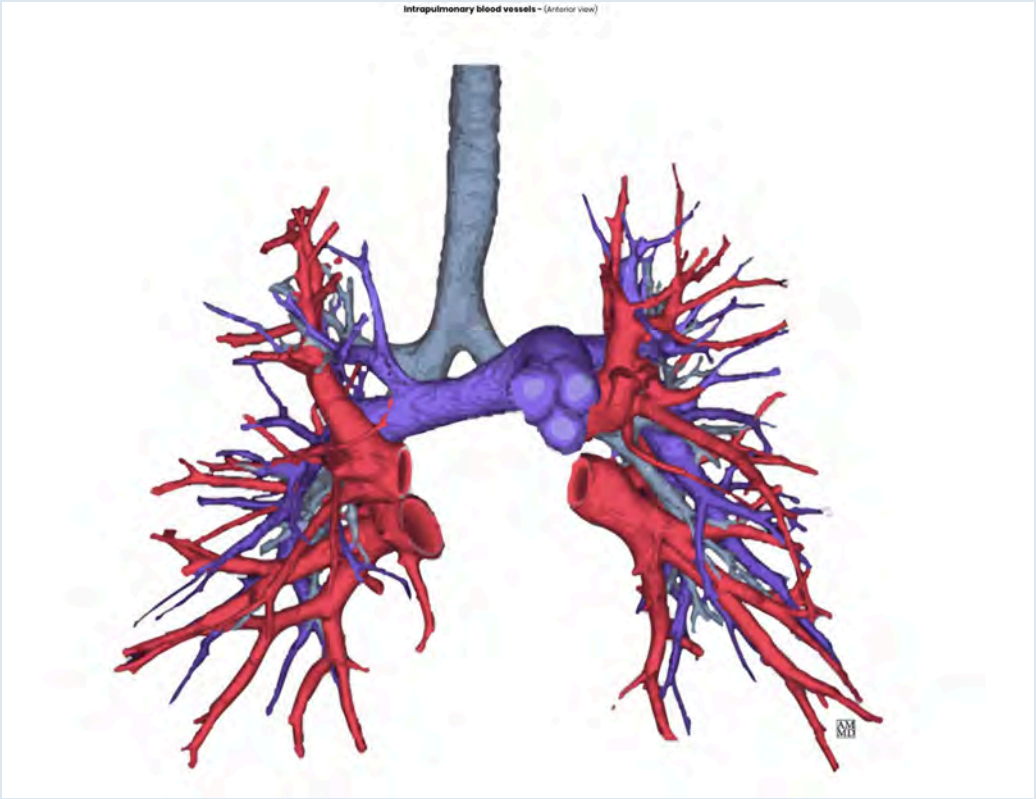



Superior division of pulmonary artery
Trachea
Right main bronchus
Upper lobe bronchus
Right pulmonary artery
Apicoposterior branch
Superior segment artery
Superior segment bronchus
Middle lobe branch
Basilar branches
Middle lobe bronchus
A
Pulmonary trunk
Apicoposterior branch
Left main bronchus
Anterior branch
Lingular branches
Left pulmonary artery
Superior segment artery
Superior segment bronchus
Upper lobe bronchus
Lingular bronchus
Basilar branches
B

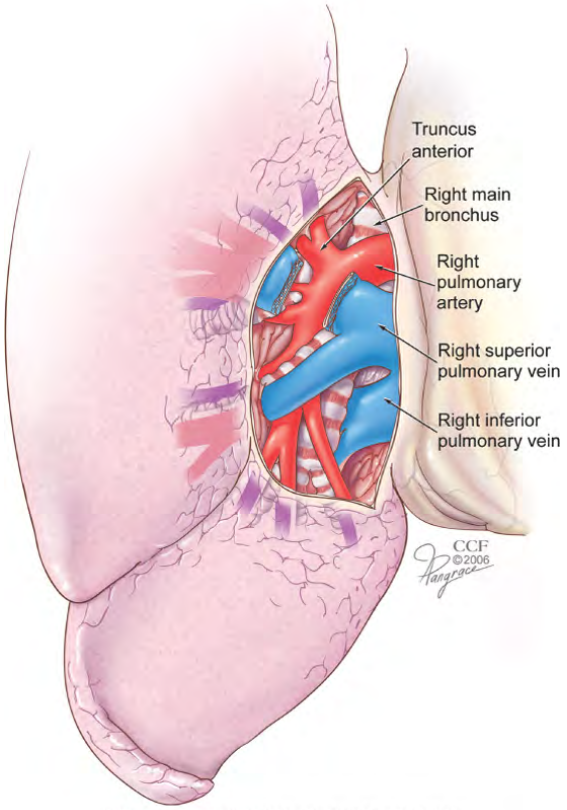




# Including the veins…



# Hilar anatomy

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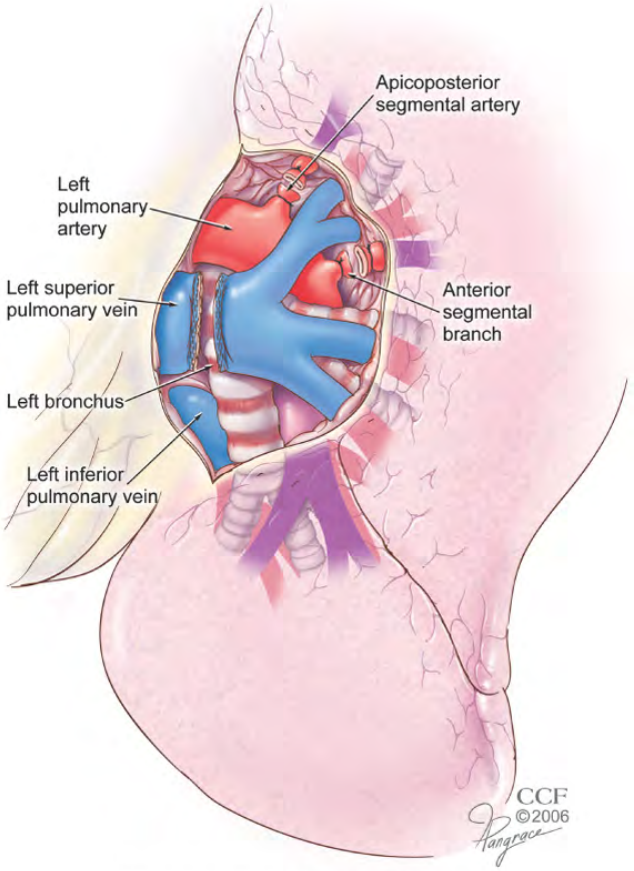


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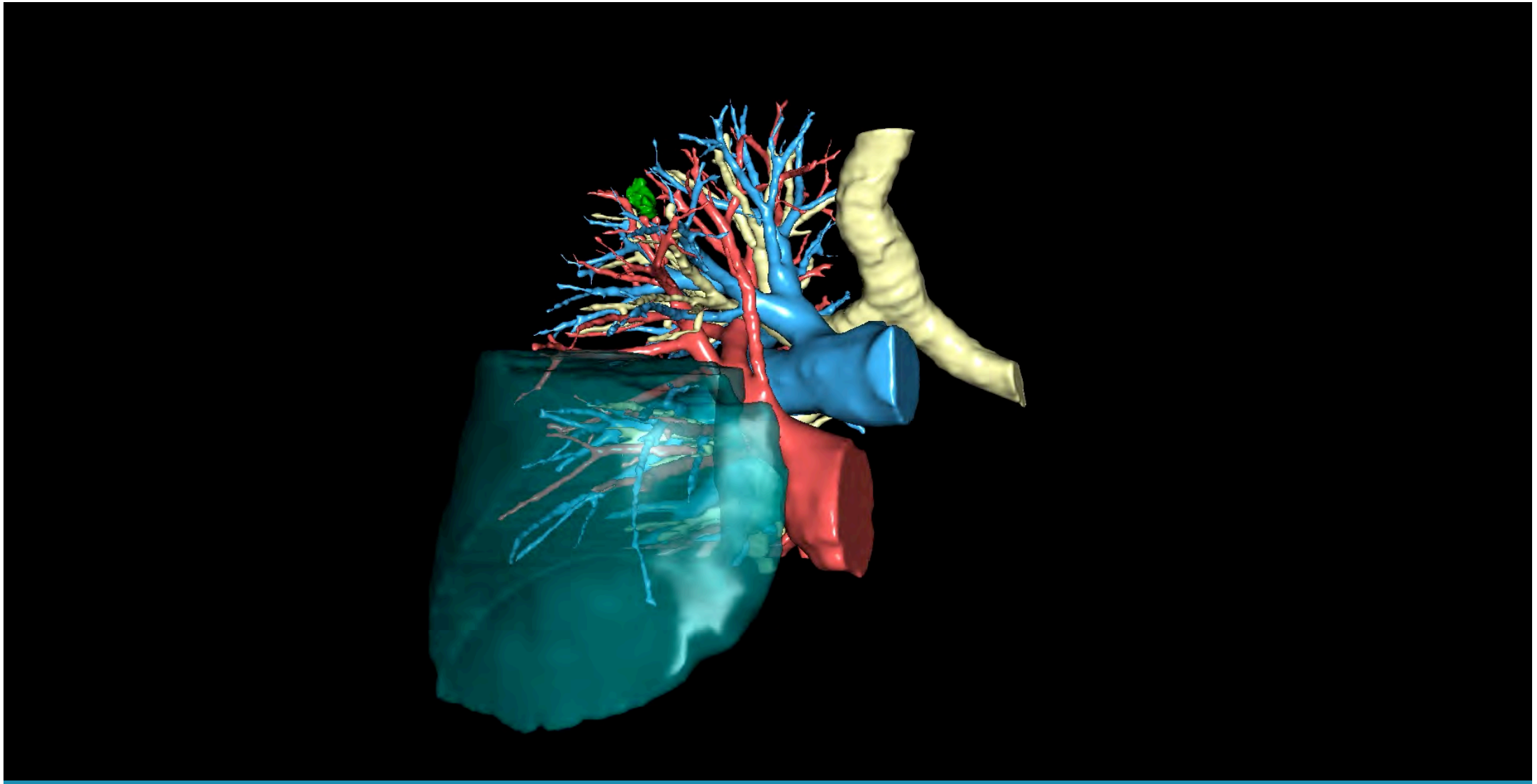


# Lymph Node Map

# Lymph node dissection during anatomical resections for NSCLC

## GOAL

Complete Resection
Correct Staging

## Acceptable Risk – Benefit ratio

# The IASLC Lung Cancer Staging Project: Analysis Of Resection Margin Status And Proposals For R Status Descriptors For Non-small Cell Lung Cancer

Edwards et al. WCLC PL 02.06

- R0 complete resection
- R1 microscopic residual disease
- R2 macroscopic residual disease
- NEW: R(un) – R UNCERTAIN

**Resection margins are proved to be free of disease microscopically, but one of the following applies:**

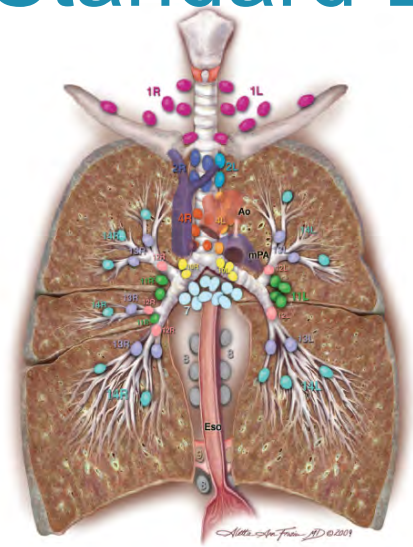
- less than 3 N1 or N2 nodes examined
- less than lobe-specific Systematic Lymph Node Dissection
- Extra-Capsular Invasion ( ECI ) of N2 nodes
- positive highest lymph node ***station*** (status of highest *node* unavailable)
- *carcinoma in situ* at bronchial resection margin (currently R1(i.s.))
- positive pleural lavage cytology (currently R1(cy+))

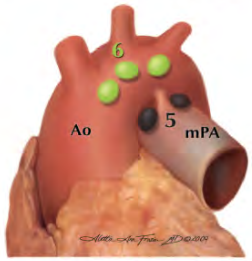
# Lobe specific lymphadenectomy for cT1:
# Three mediastinal stations and always 7

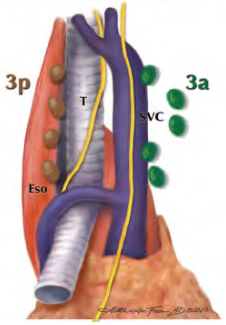
- right upper and middle lobe: 2R, 4R and 7;
- right lower lobe: 4R, 7, 8 and 9;
- left upper lobe: 5, 6 and 7;
- left lower lobe: 7, 8 and 9.

**all lobar and interlobar nodes**

# Standard Lymphadenectomy




*Supraclavicular zone*
- 1 Low cervical, supraclavicular, and sternal notch nodes

**SUPERIOR MEDIASTINAL NODES**

*Upper zone*
- 2R Upper Paratracheal (right)
- 2L Upper Paratracheal (left)
- 3a Prevascular
- 3p Retrotracheal
- 4R Lower Paratracheal (right)
- 4L Lower Paratracheal (left)

**AORTIC NODES**

*AP zone*
- 5 Subaortic
- 6 Para-aortic (ascending aorta or phrenic)

**INFERIOR MEDIASTINAL NODES**

*Subcarinal zone*
- 7 Subcarinal

*Lower zone*
- 8 Paraesophageal (below carina)
- 9 Pulmonary ligament

**N1 NODES**

*Hilar/Interlobar zone*
- 10 Hilar
- 11 Interlobar

*Peripheral zone*
- 12 Lobar
- 13 Segmental
- 14 Subsegmental

Minimal:

N1 Nodes

3 mediastinal positions

Always position 7

RIGHT

Low. border cricoid

1R

Up. Manubrium / Apex

2R

Low. border Innominate v.

4R

Low. Azygos Vein

10R

Interlobar region

Carina

7

Low. bronch intermedius

8

Inf pulm vein

9

Diaphragm

Midline


IASLC Staging Committee Article

The IASLC Lung Cancer Staging Project

*A Proposal for a New International Lymph Node Map in the Forthcoming Seventh Edition of the TNM Classification for Lung Cancer*

LEFT

Low. Border cricoid

1L

Up. Manubrium / Apex

2L

Up. Border Aortic arch

4L 6

4L Low. aortic arch

4L lig. Art. 5

Up. border Main Pulm a.

10L

Interlobar region

Carina

7

Up. lower lobe bronchus

8

Inf pulm vein

9

Diaphragm

KU LEUVEN

ELSEVIER SAUNDERS

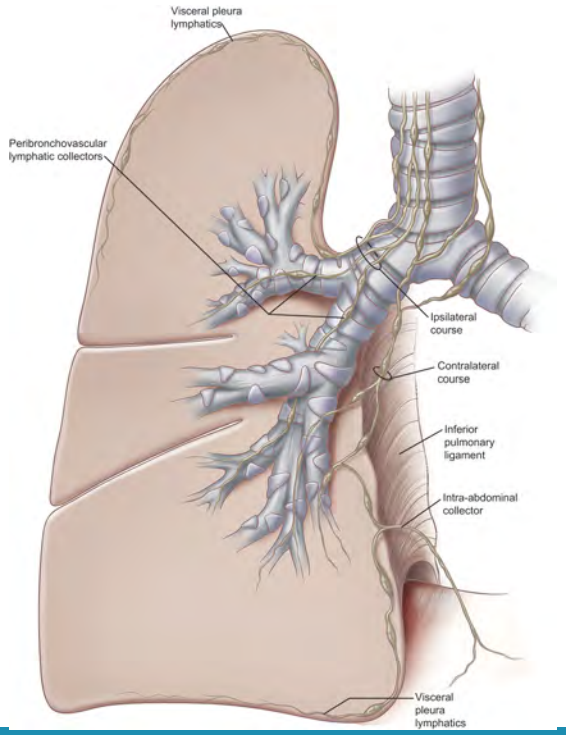
Thorac Surg Clin 17 (2007) 619–638

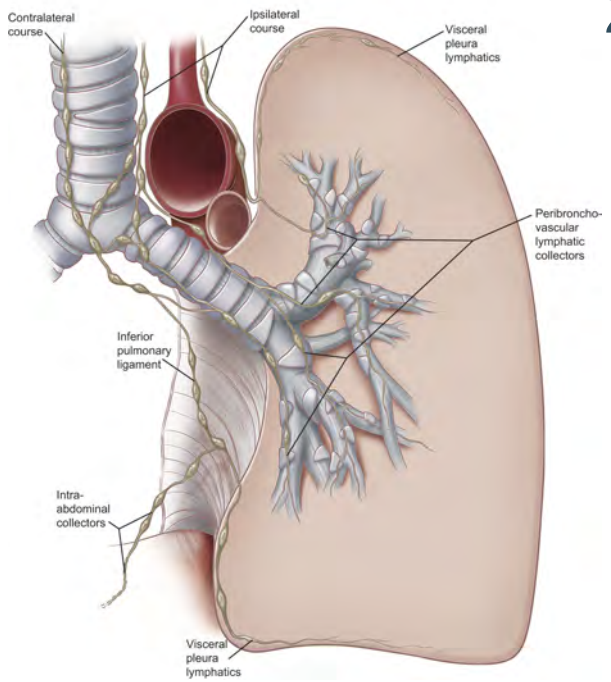
THORACIC SURGERY CLINICS

## Bronchial Arteries and Lymphatics of the Lung

Marc Riquet, MD, PhD

*Service de Chirurgie Thoracique, Hopital Européen Georges Pompidou, 20, rue Leblanc, 75015 Paris, France*

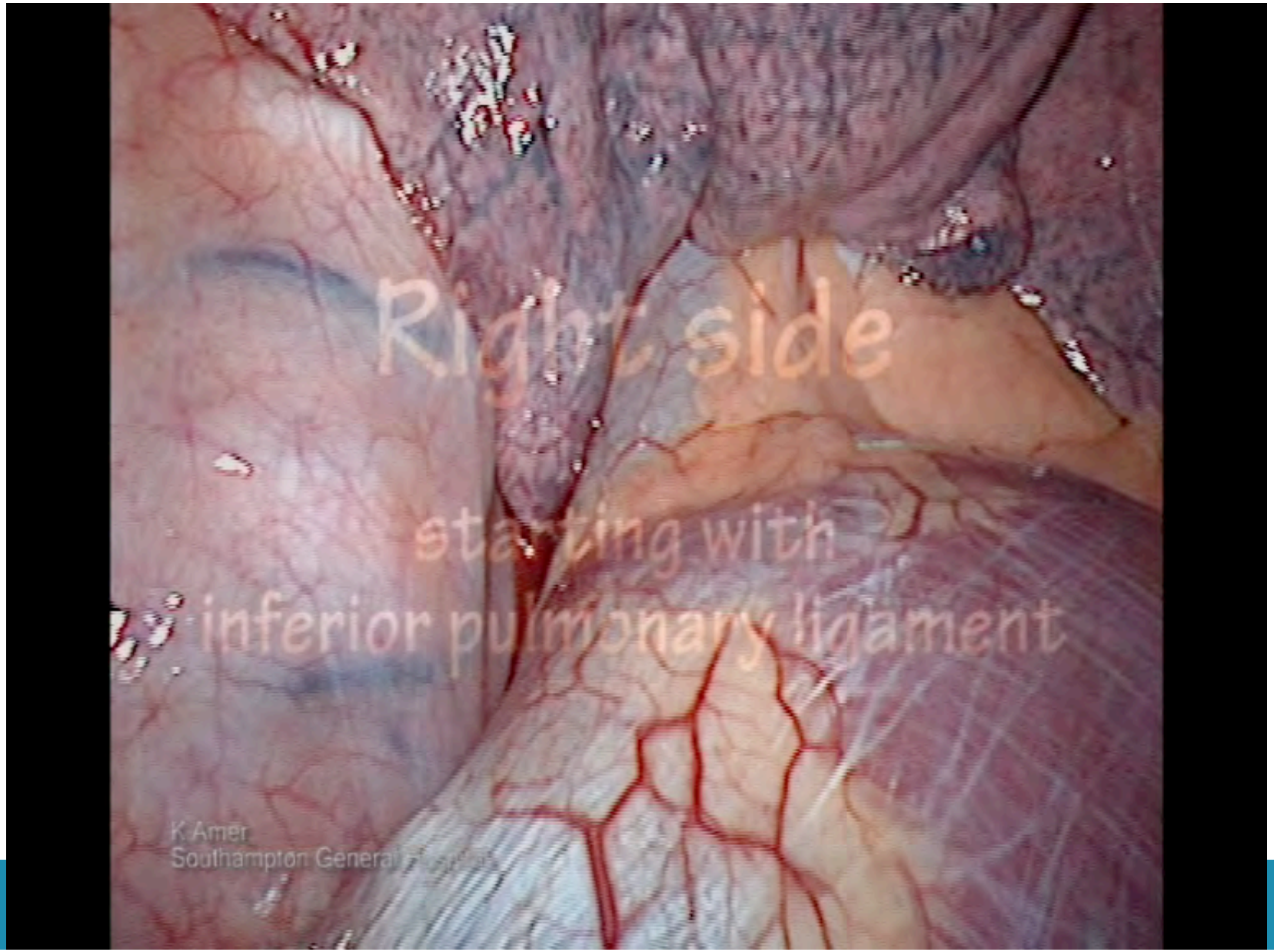



Network of lymphatics:

1. ”Superficial” or pleural plexus within the connective tissue of the visceral pleura
2. ”Deep” peribronchovascular plexus within the connective tissue surrounding airways, pulmonary arteries and veins

Lauweryns JM, Baert JH. Alveolar clearance and the role of the pulmonary lymphatics. Am Rev Respir Dis 1977;115:625–83

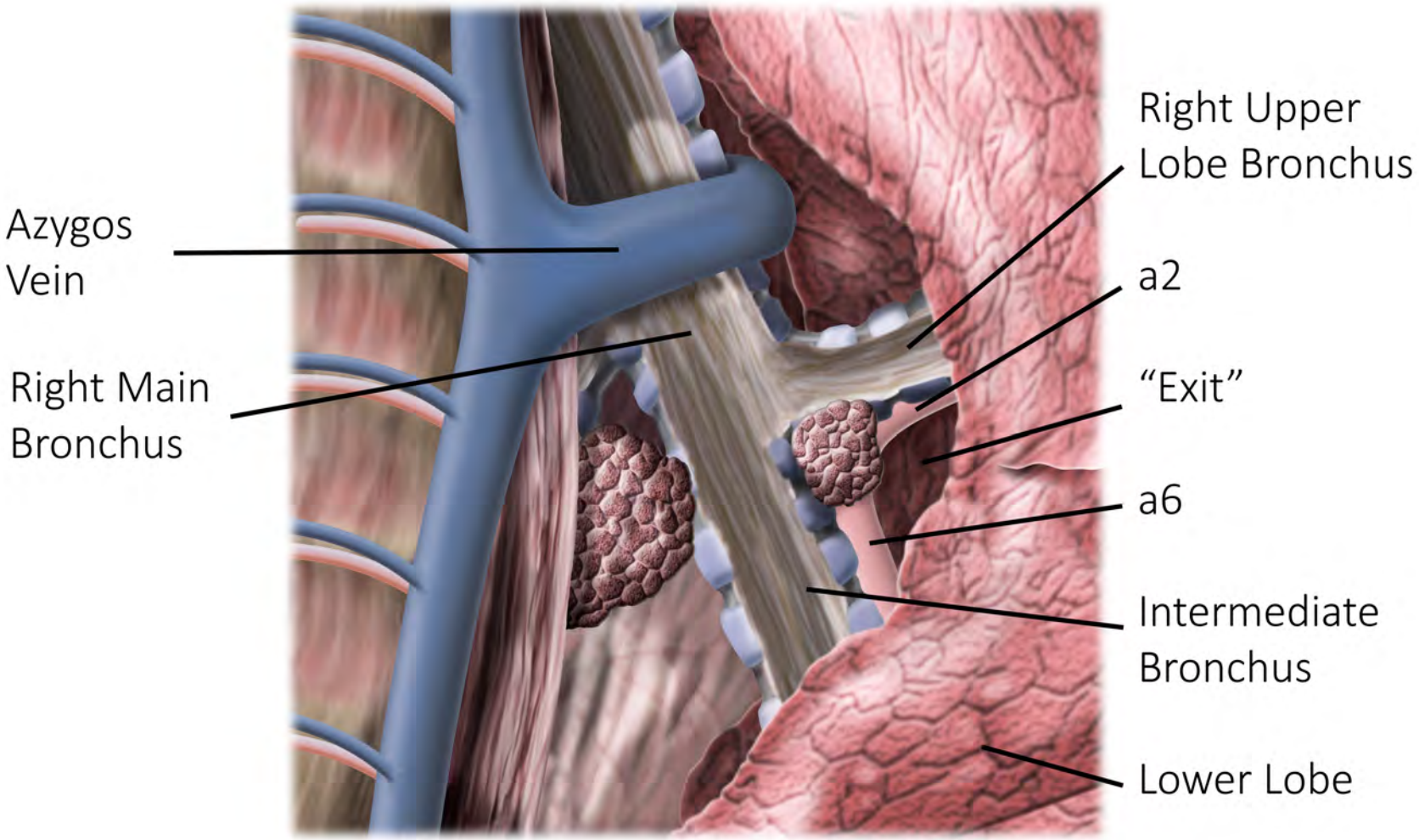

Right side
starting with
inferior pulmonary ligament
K Amer
Southampton General Hospital

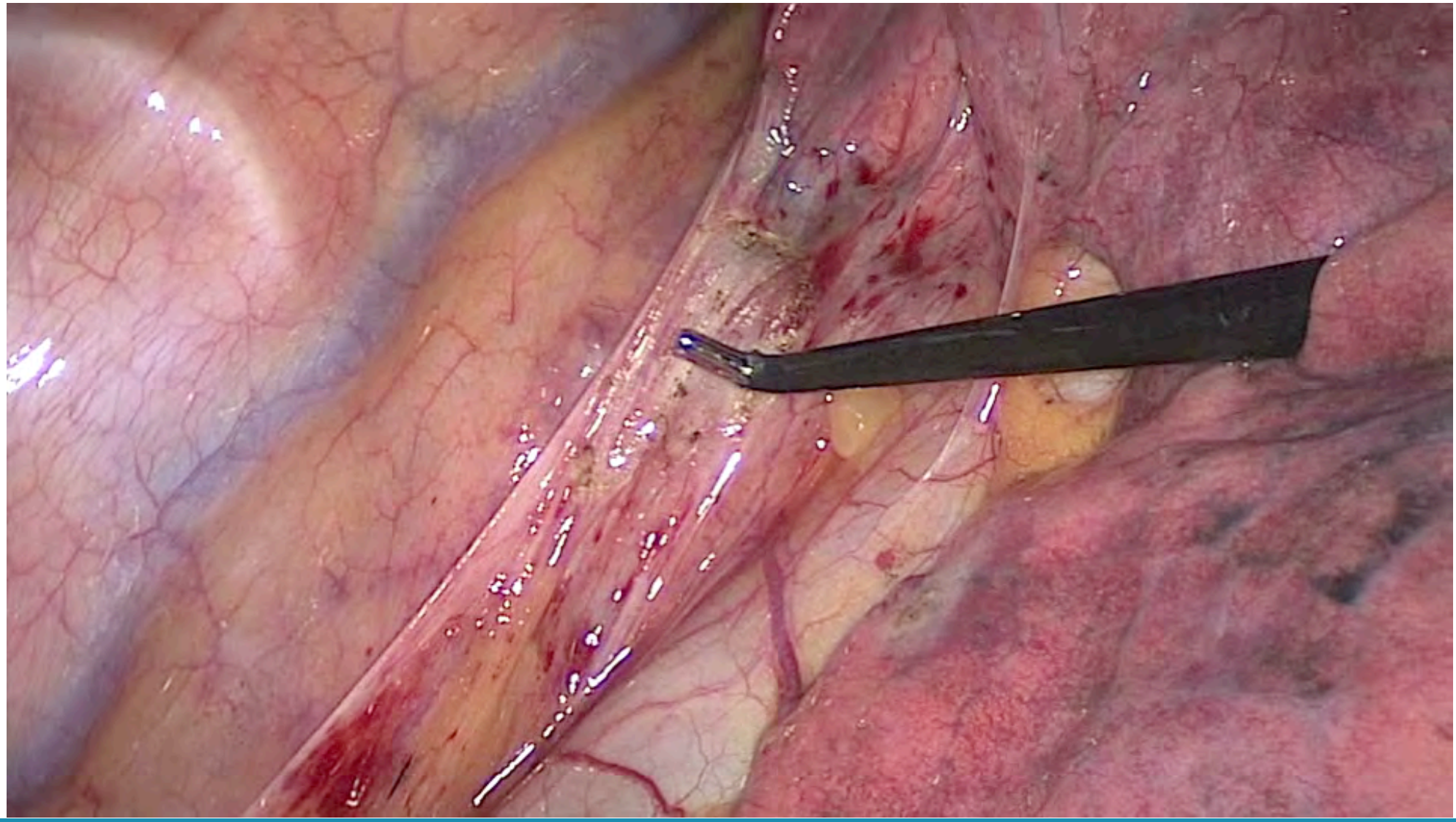
# Lymphadenectomy

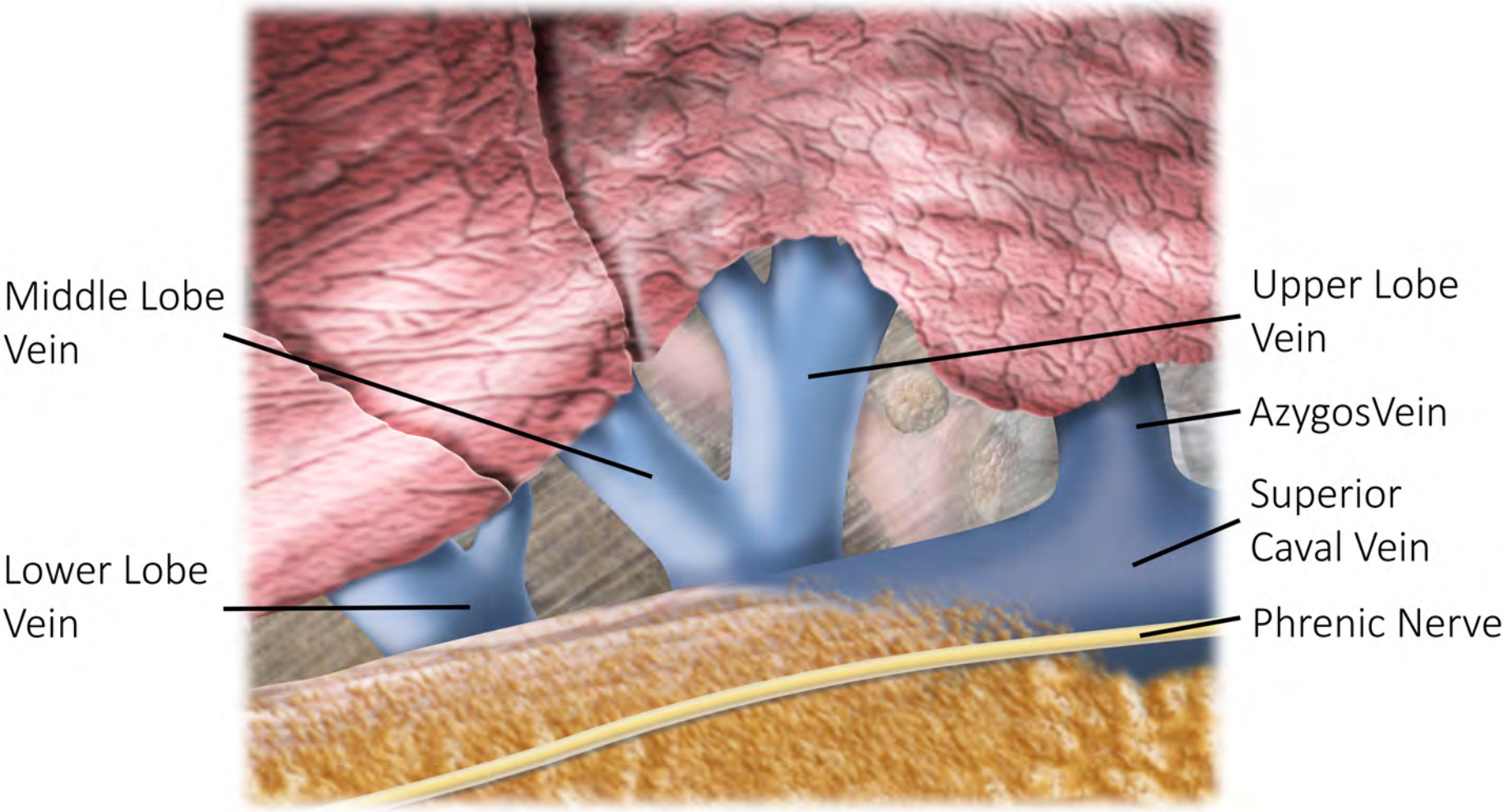
- 4R uniportal
- 4R RATS

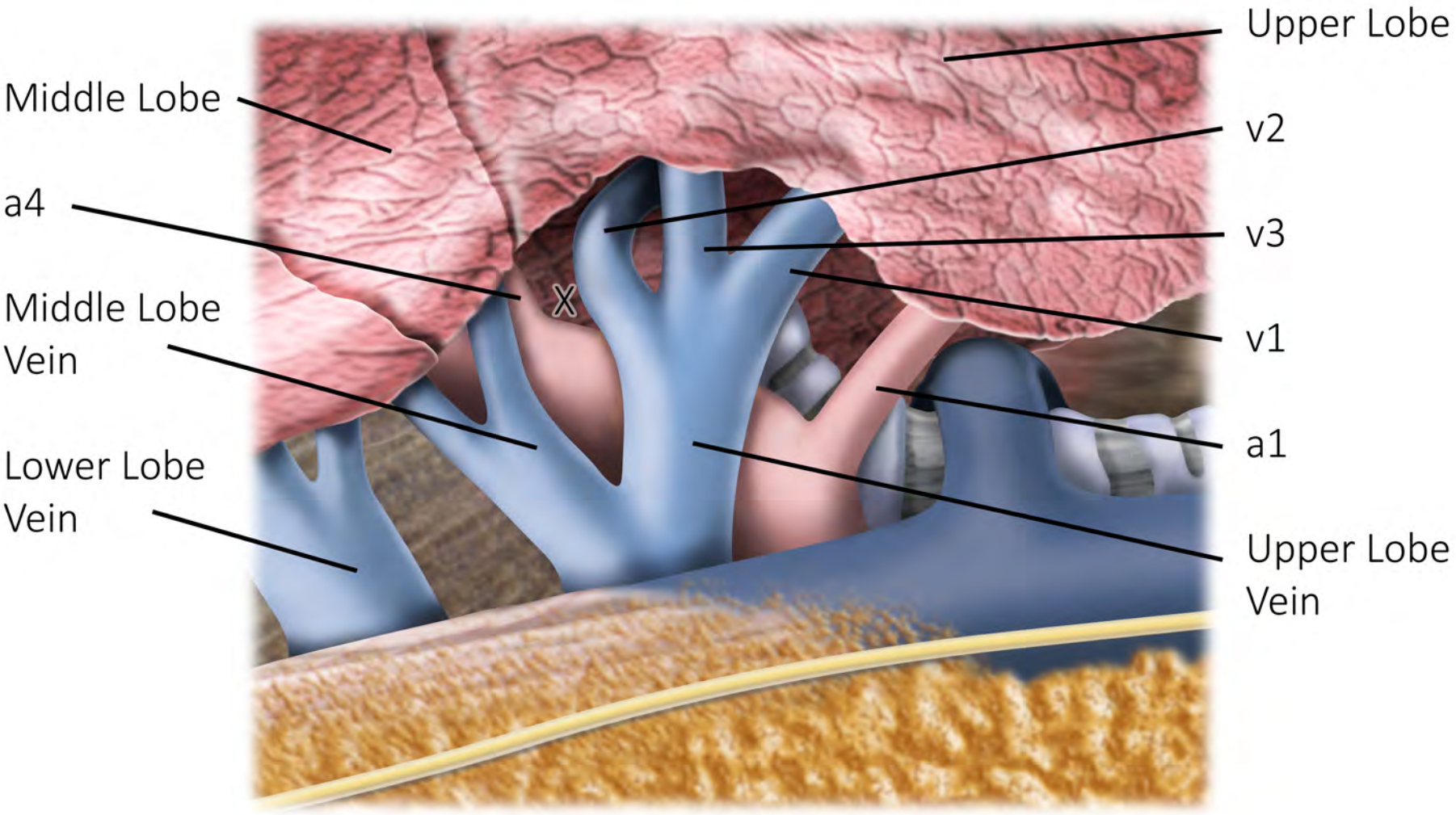
# Procedural Steps
# VATS Anatomical Resections

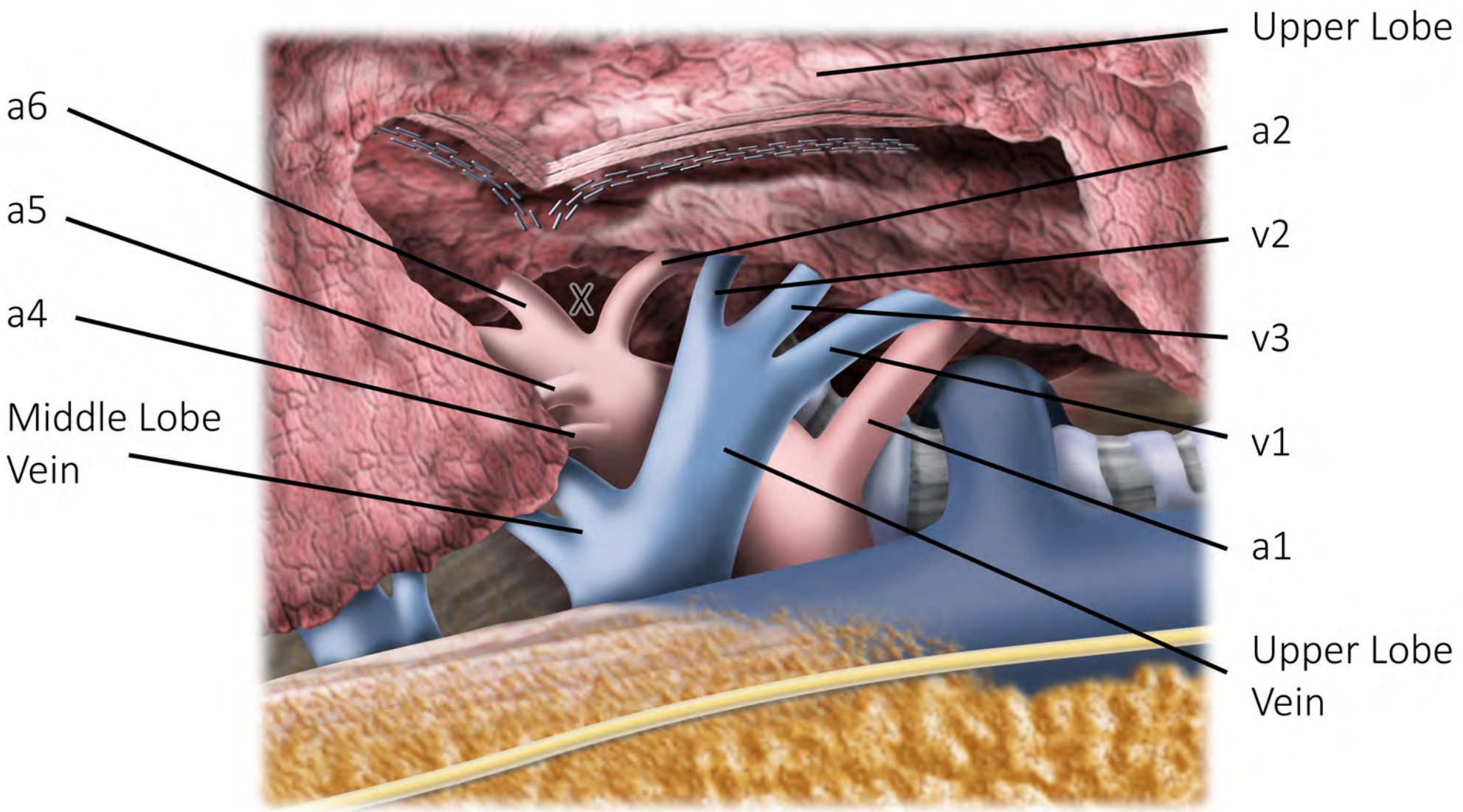
# Right Upper Lobe

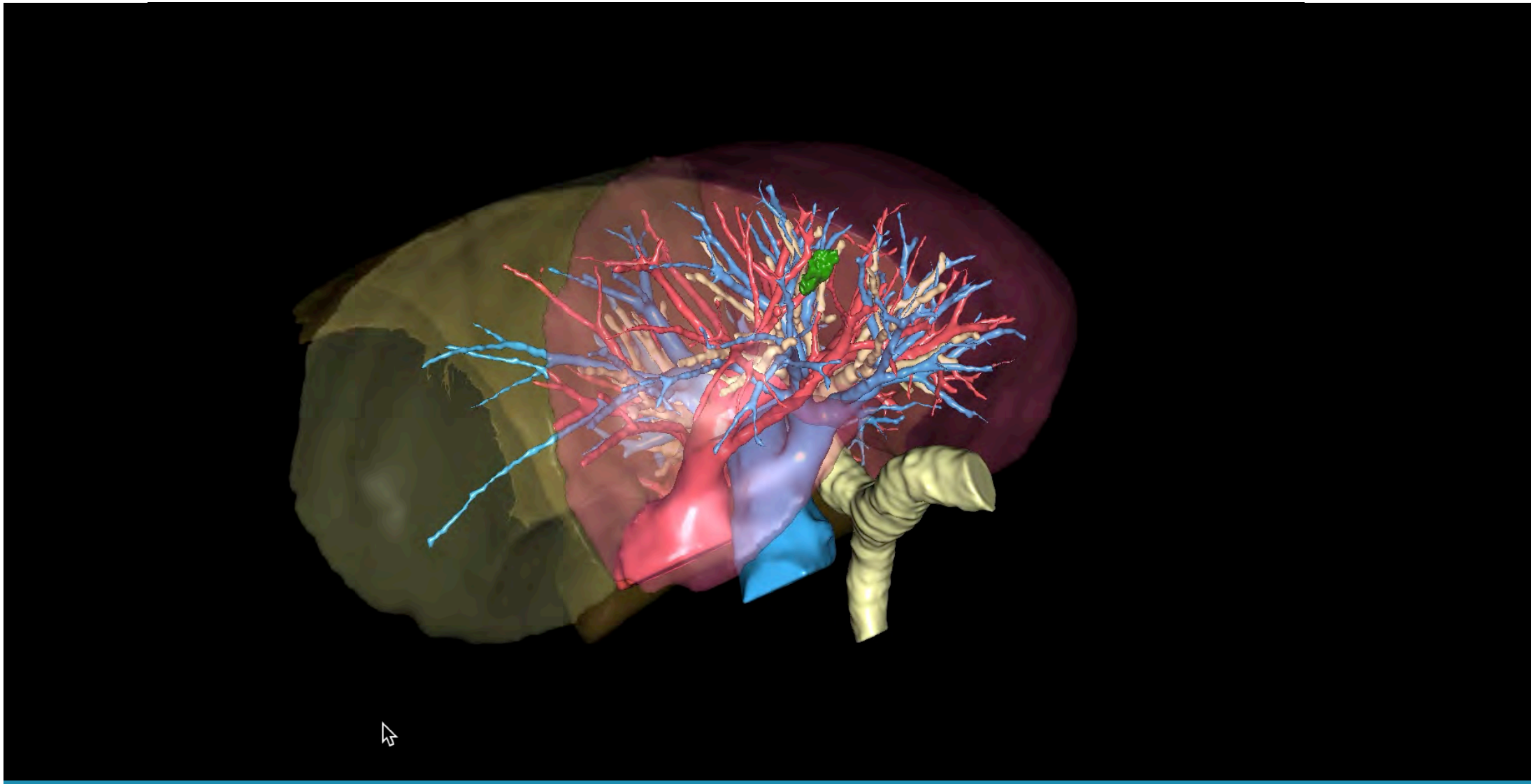

Azygos Vein
Right Main Bronchus
Right Upper Lobe Bronchus
a2
"Exit"
a6
Intermediate Bronchus
Lower Lobe



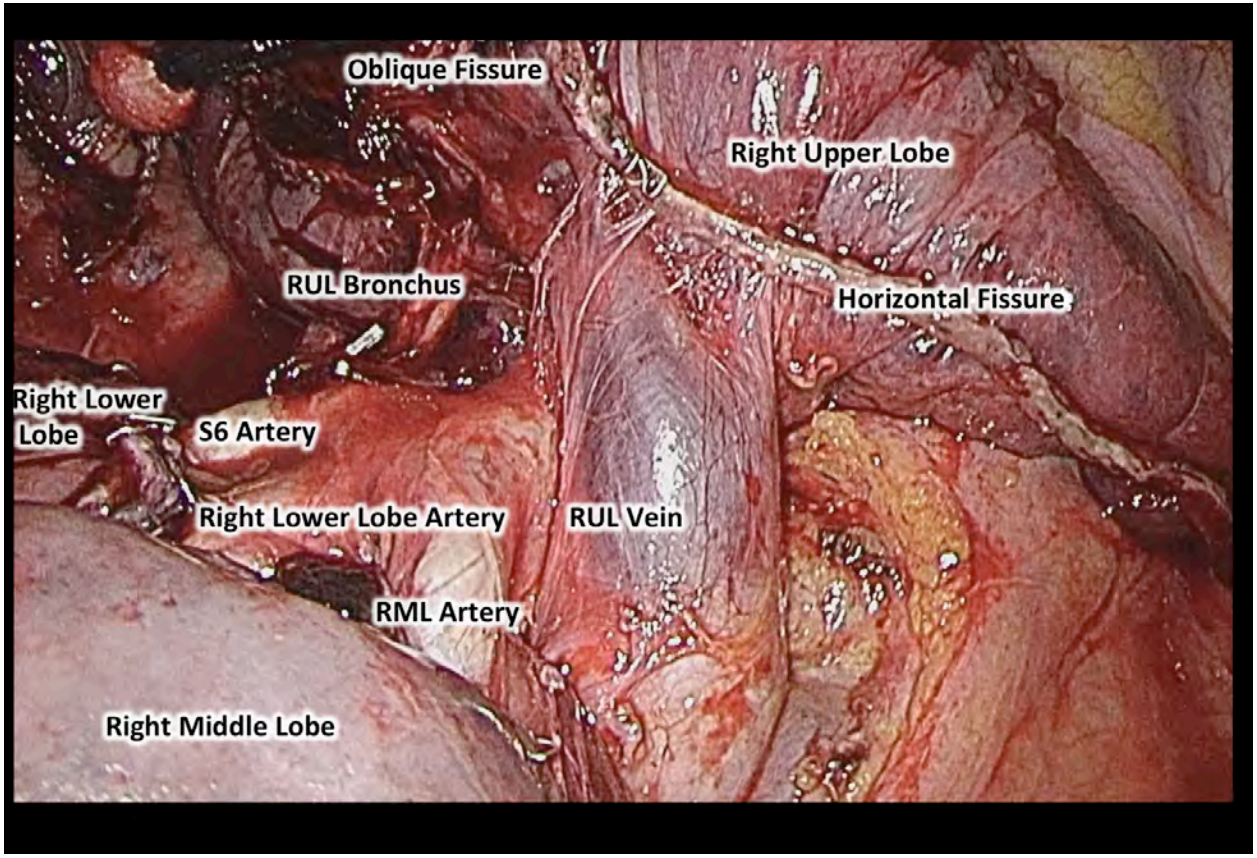

Middle Lobe Vein
Upper Lobe Vein
AzygosVein
Superior Caval Vein
Lower Lobe Vein
Phrenic Nerve


Middle Lobe
a4
Middle Lobe Vein
Lower Lobe Vein
X
Upper Lobe
v2
v3
v1
a1
Upper Lobe Vein

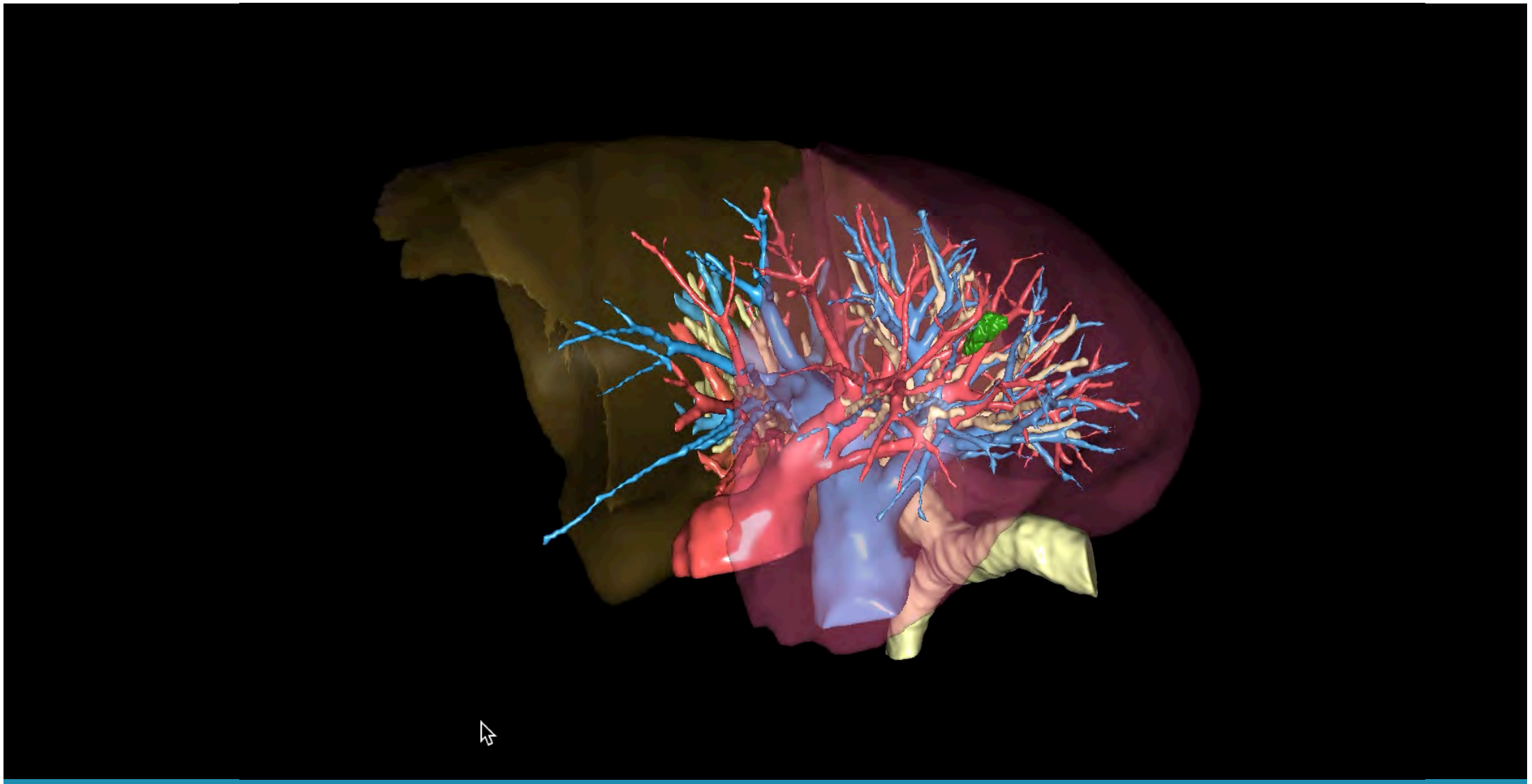

Upper Lobe
a6
a2
a5
v2
a4
v3
Middle Lobe
Vein
v1
a1
Upper Lobe
Vein



# Right upper lobe



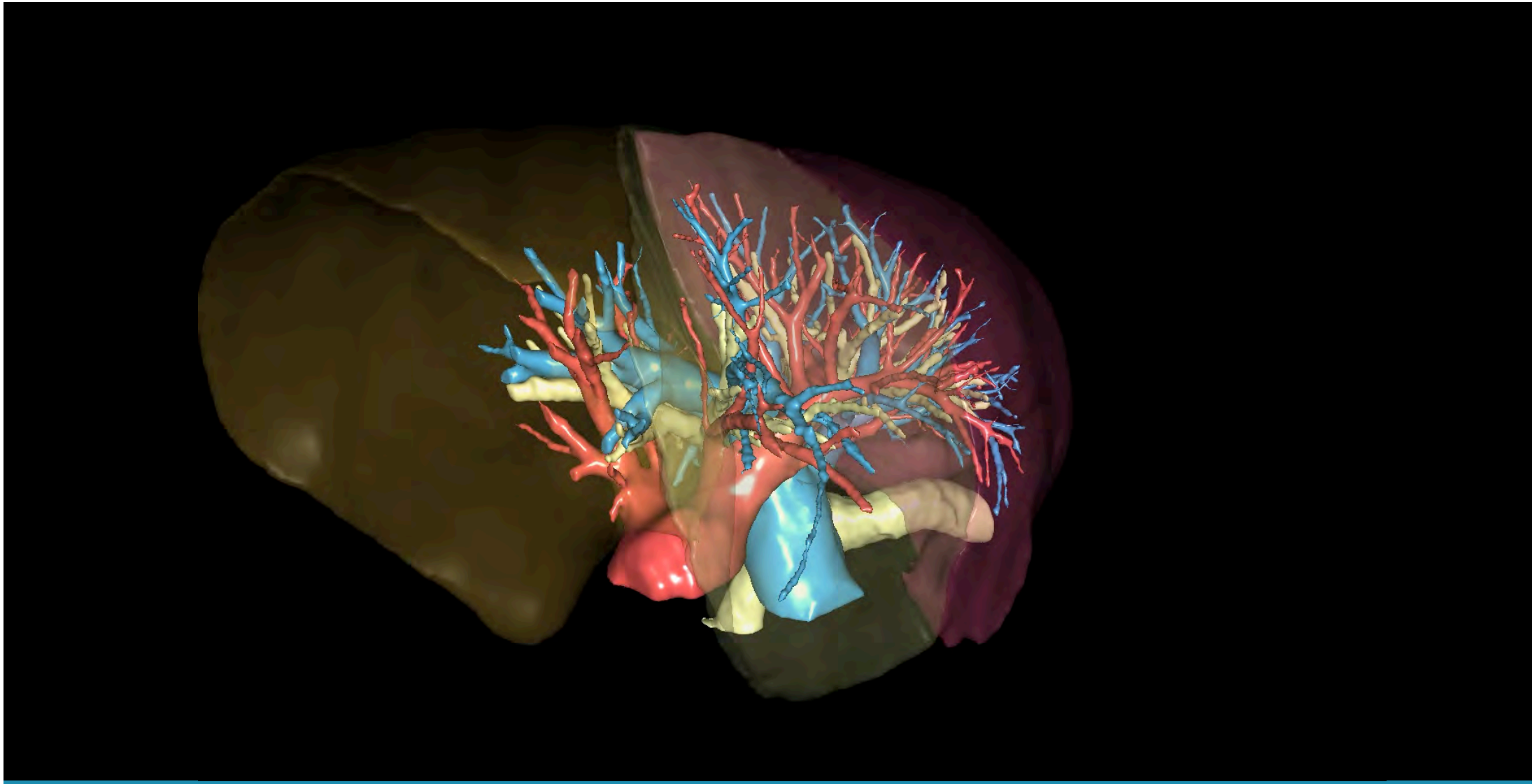
# Right Middle Lobe

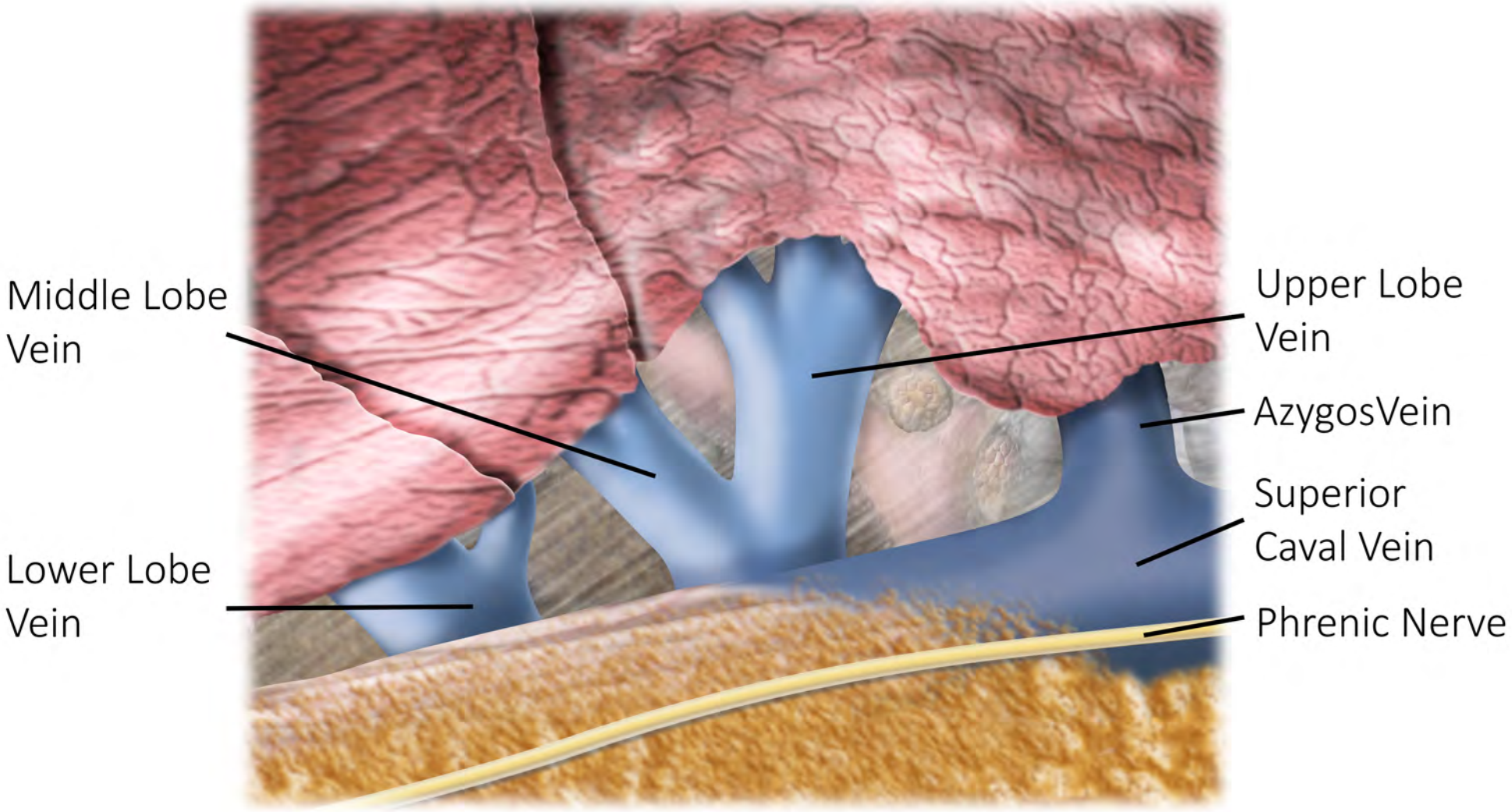


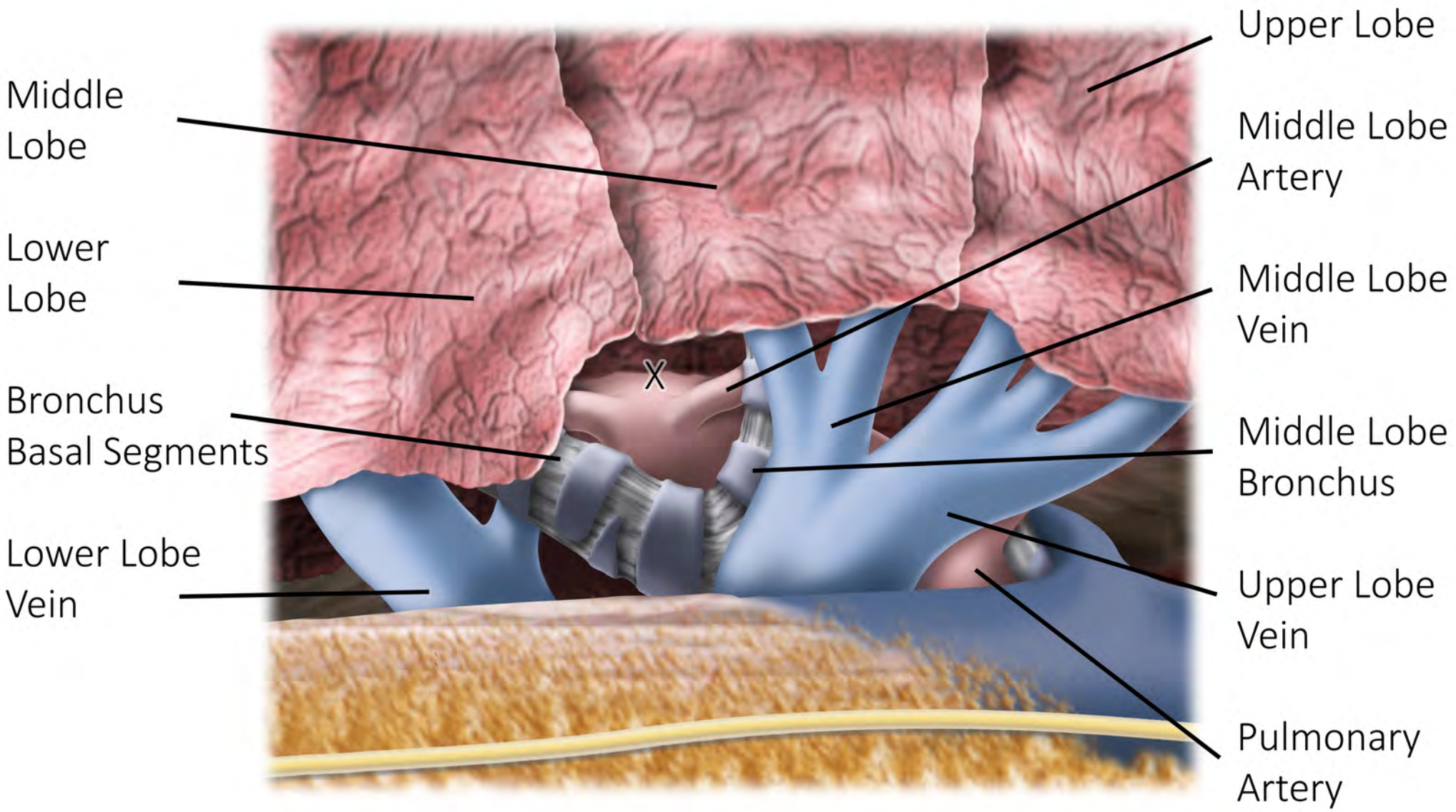
# Middle lobectomy

- Uniportal middle lobectomy
- RATS middle lobectomy

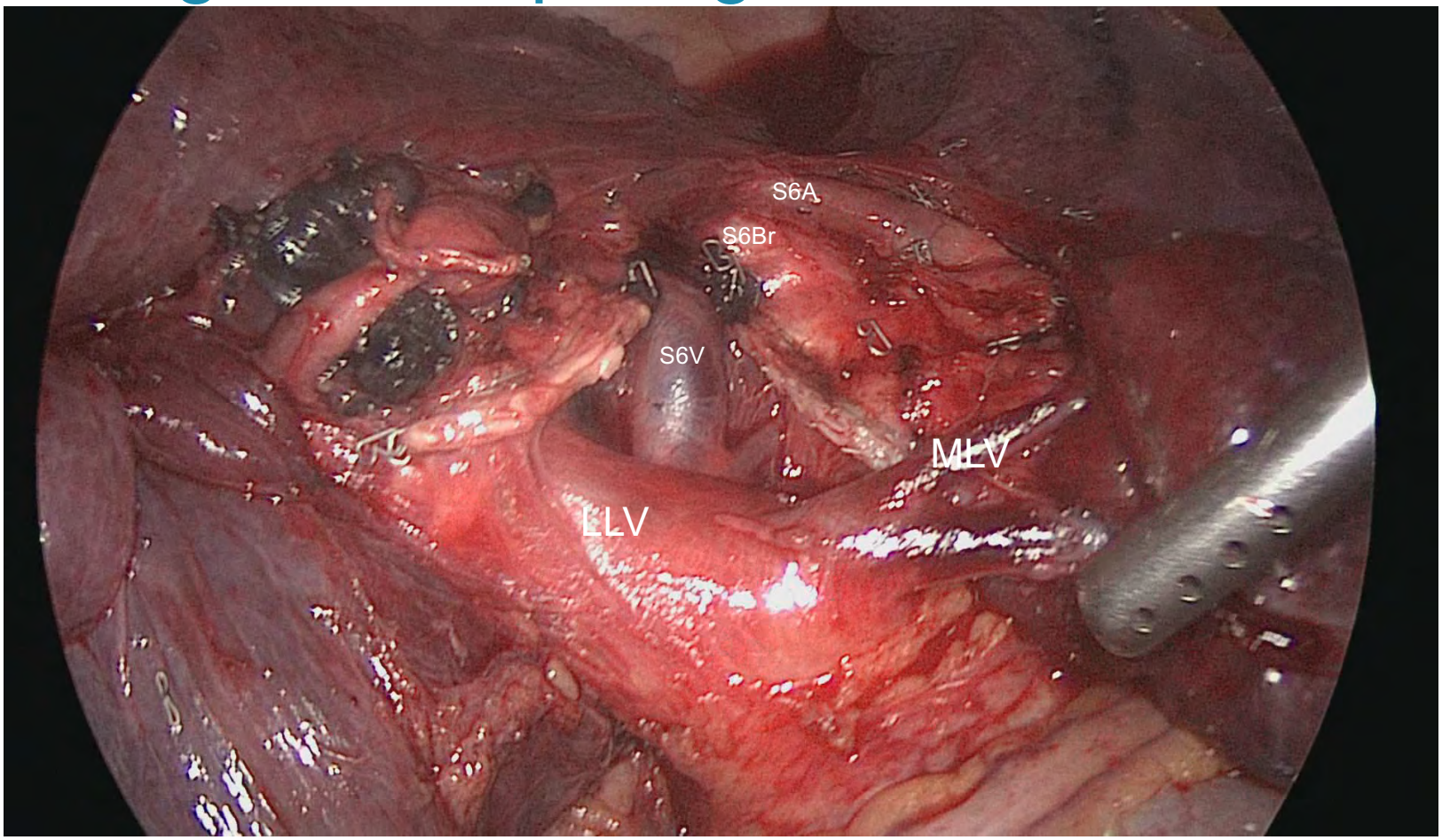
# Right Lower Lobe

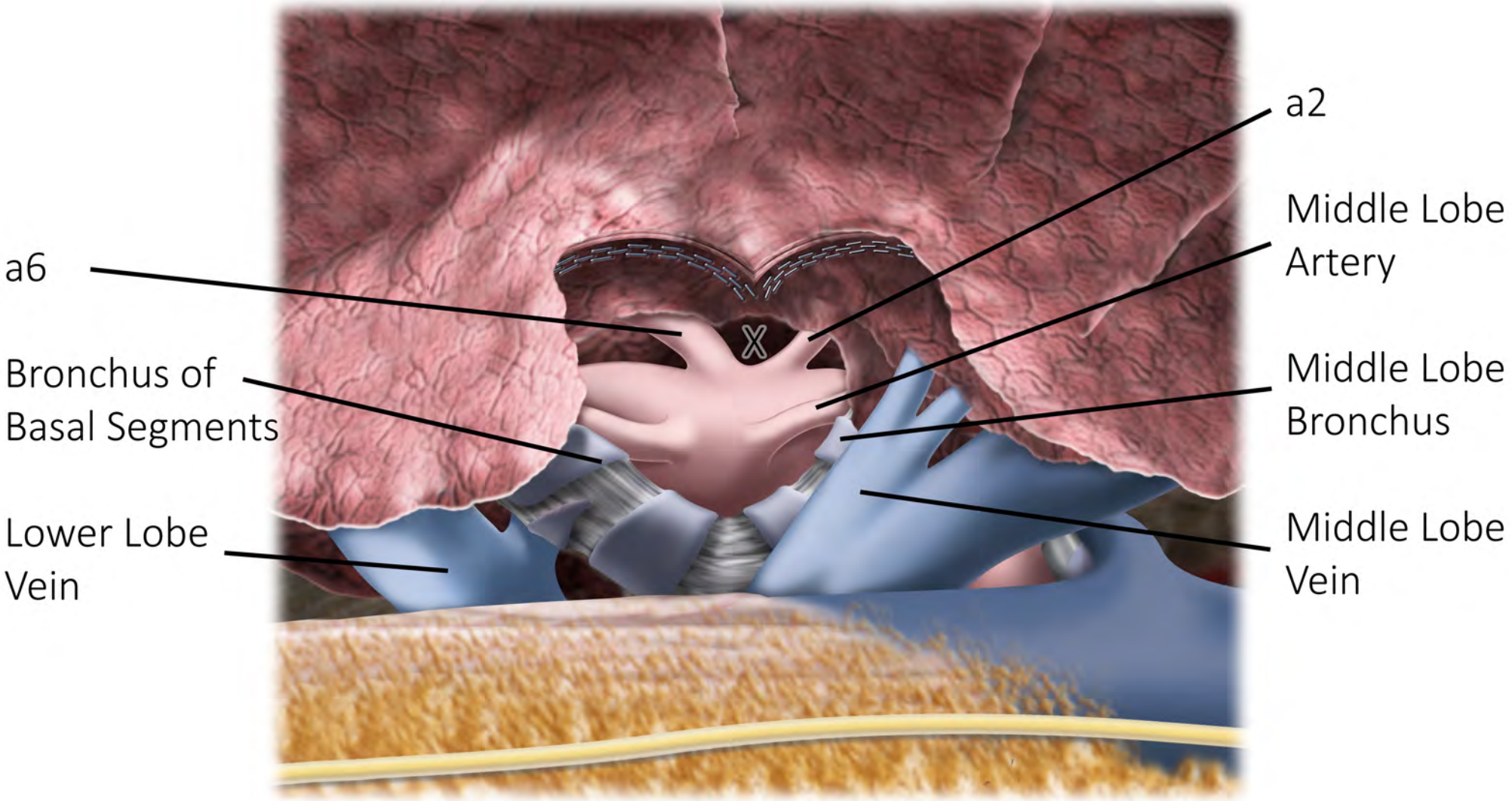



Middle Lobe Vein
Upper Lobe Vein
AzygosVein
Superior Caval Vein
Lower Lobe Vein
Phrenic Nerve

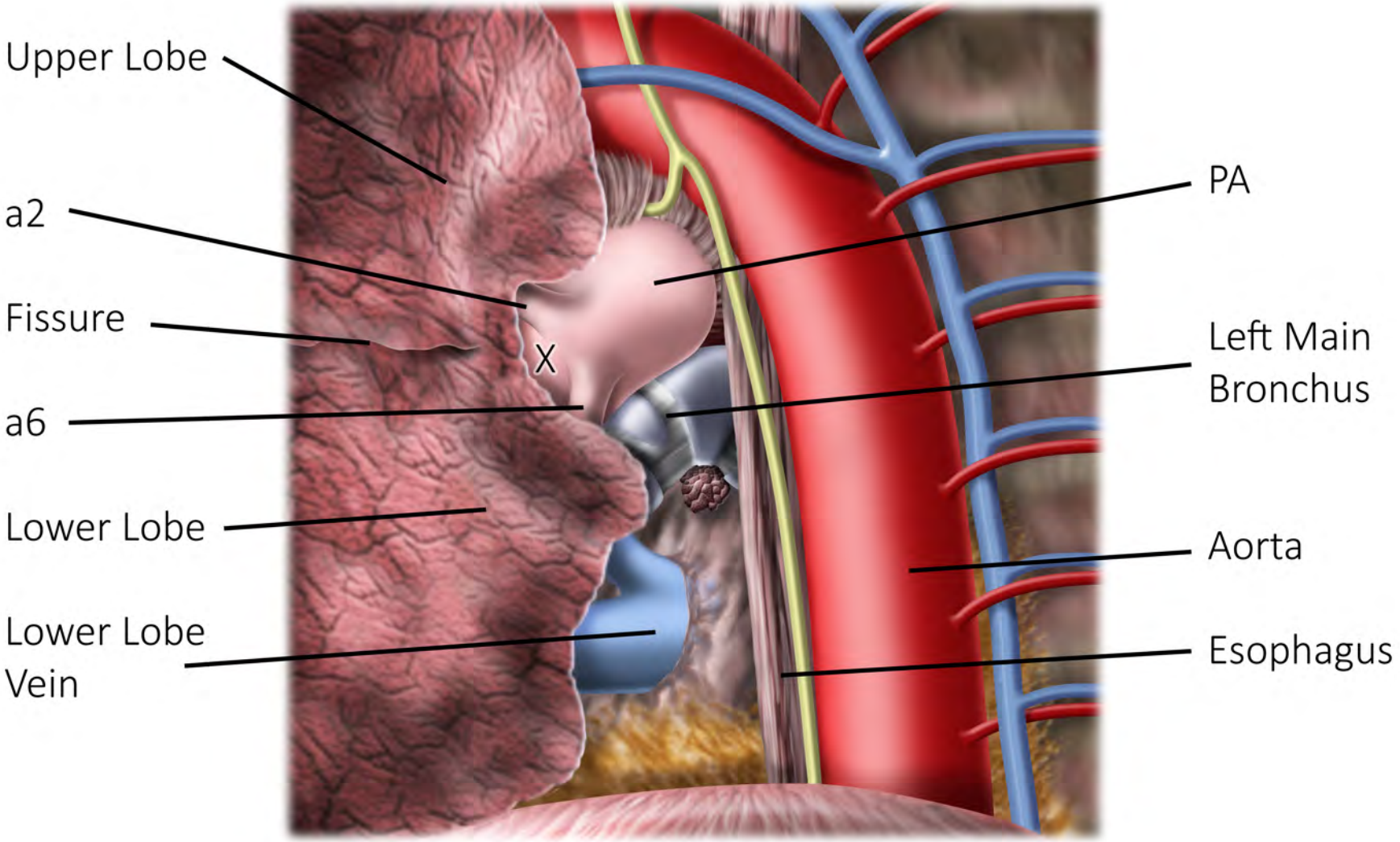

Middle Lobe
Lower Lobe
Bronchus Basal Segments
Lower Lobe Vein
X
Upper Lobe
Middle Lobe Artery
Middle Lobe Vein
Middle Lobe Bronchus
Upper Lobe Vein
Pulmonary Artery

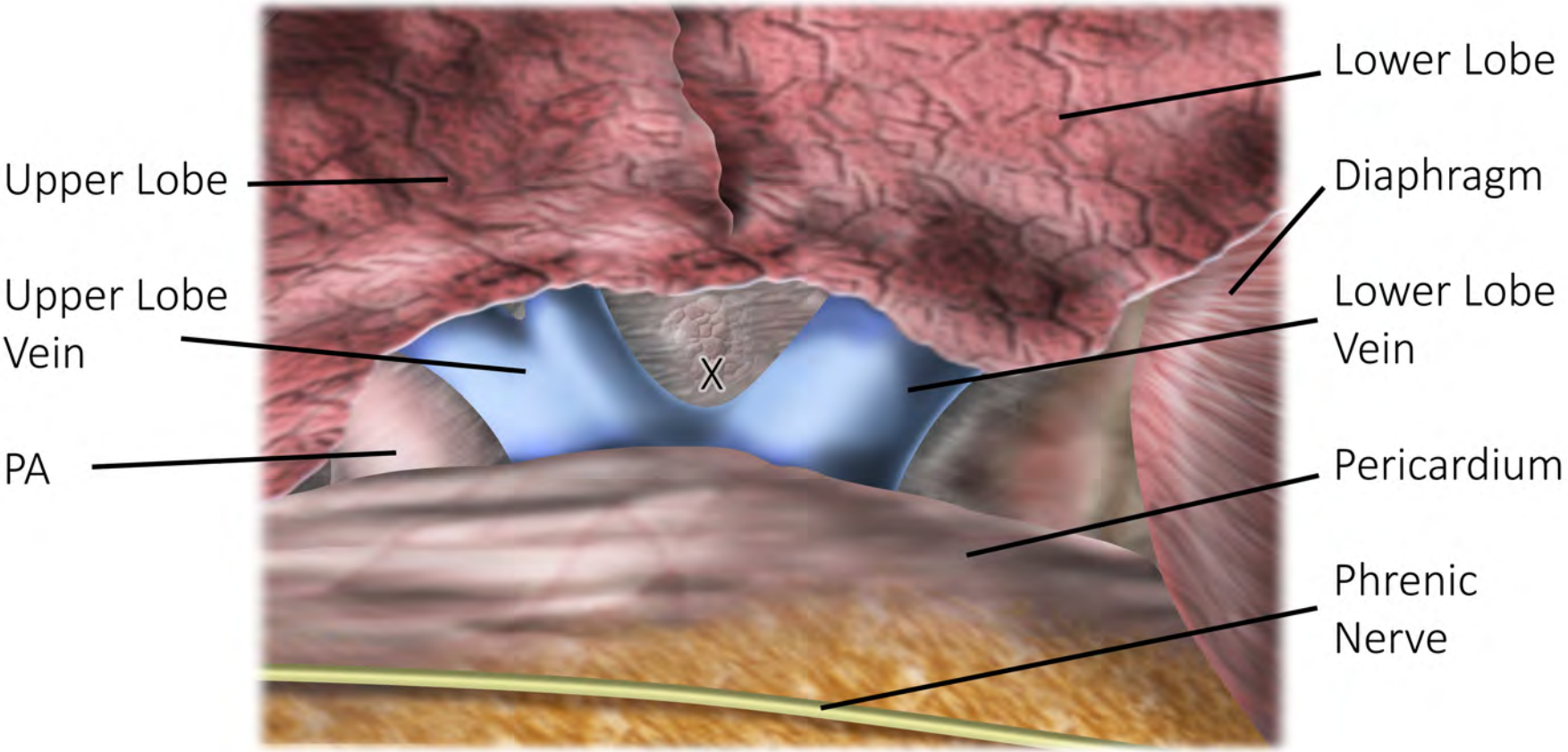
# Segment 6 sparing RLL

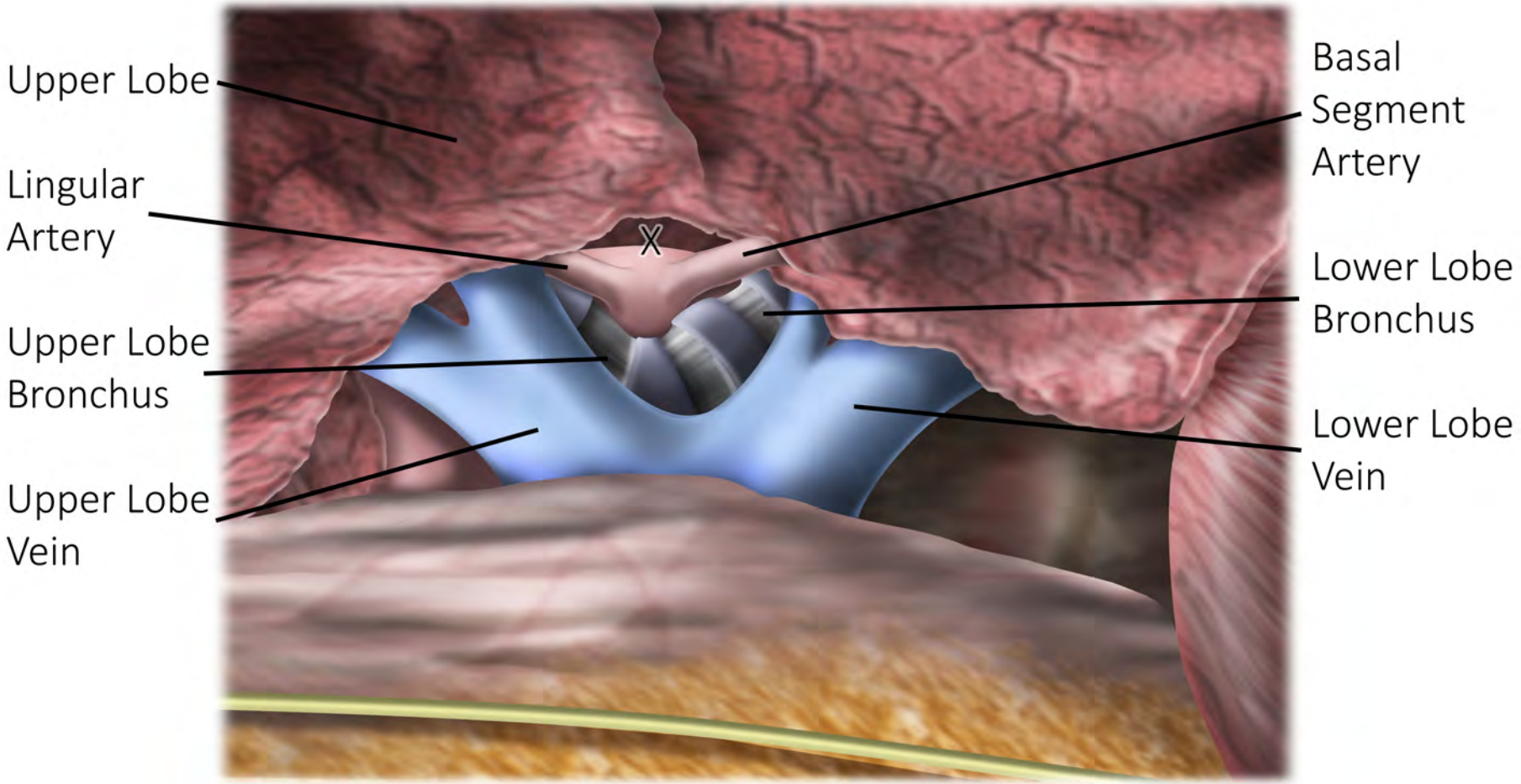


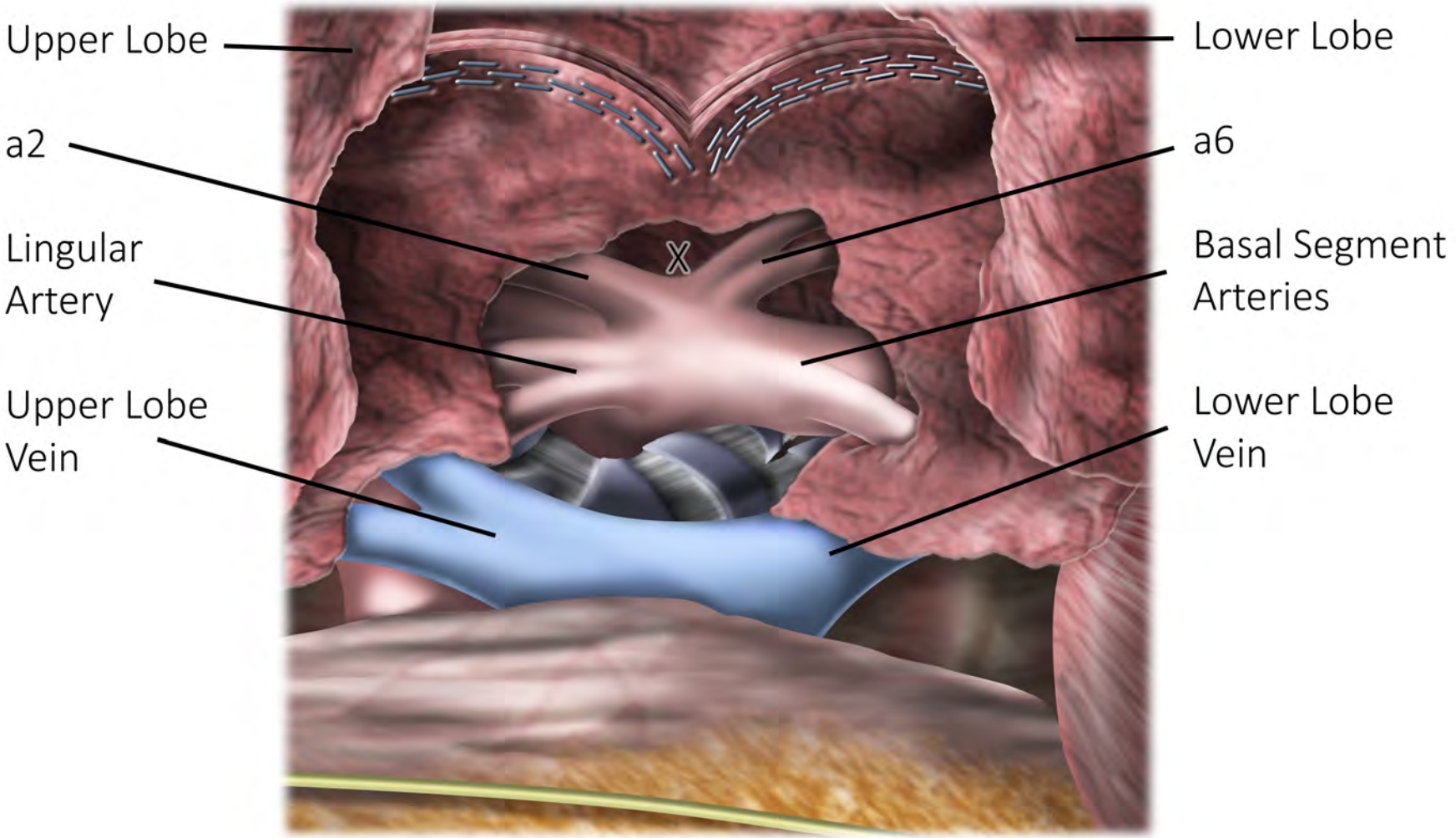

a2
Middle Lobe Artery
a6
Middle Lobe Bronchus
Bronchus of Basal Segments
Middle Lobe Vein
Lower Lobe Vein

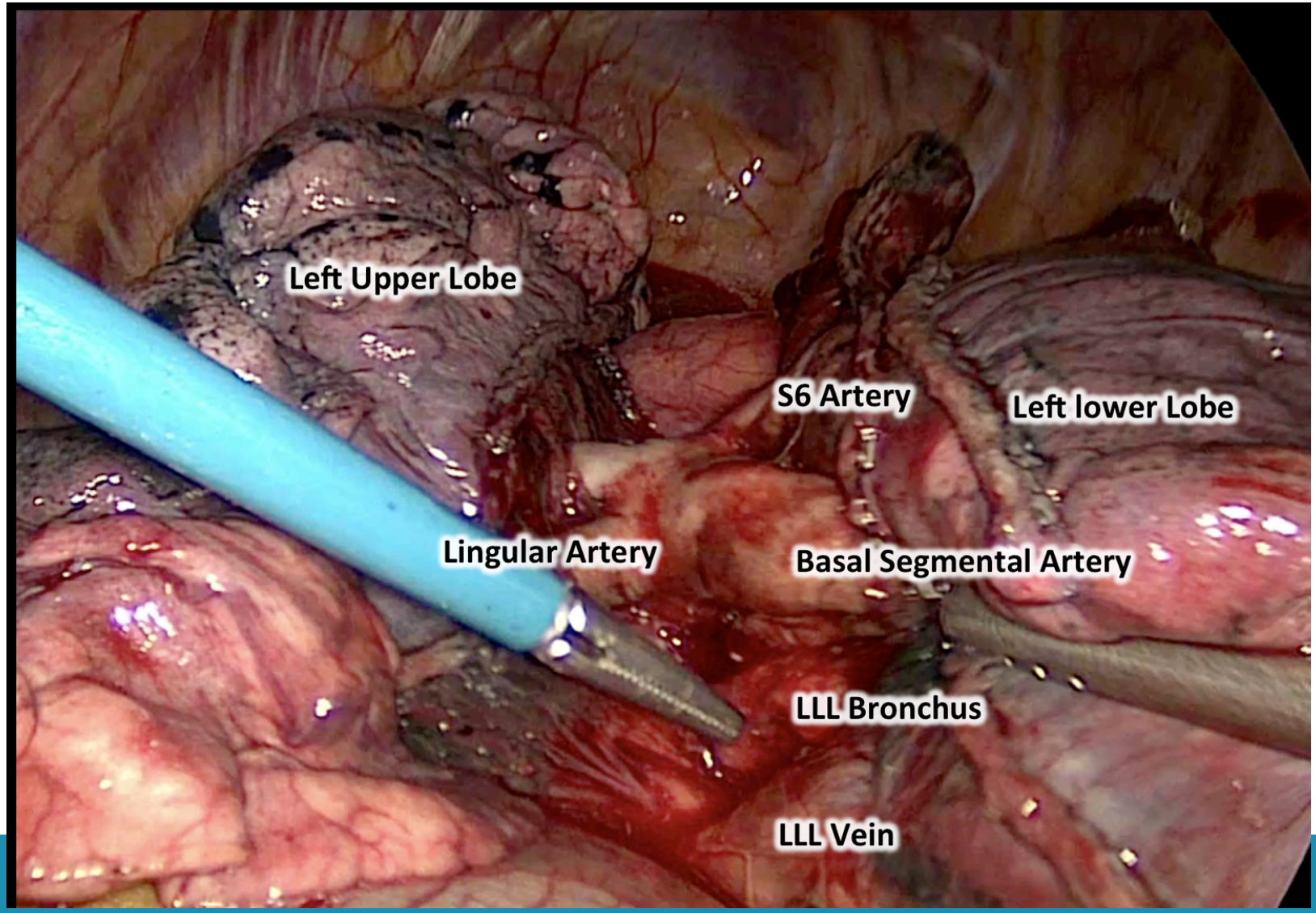
# Left Upper & Lower Lobe

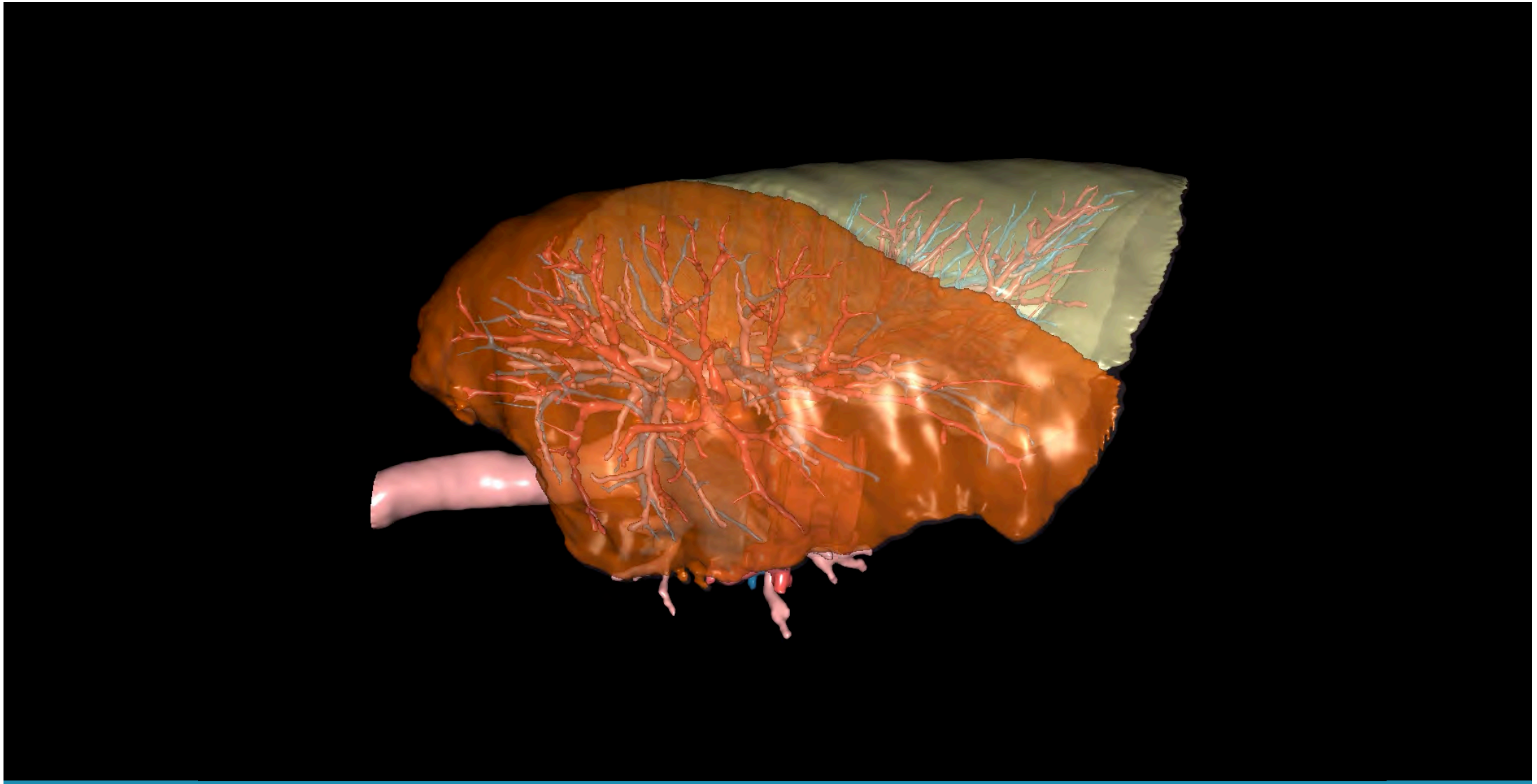

Upper Lobe
a2
Fissure
X
a6
Lower Lobe
Lower Lobe Vein
PA
Left Main Bronchus
Aorta
Esophagus

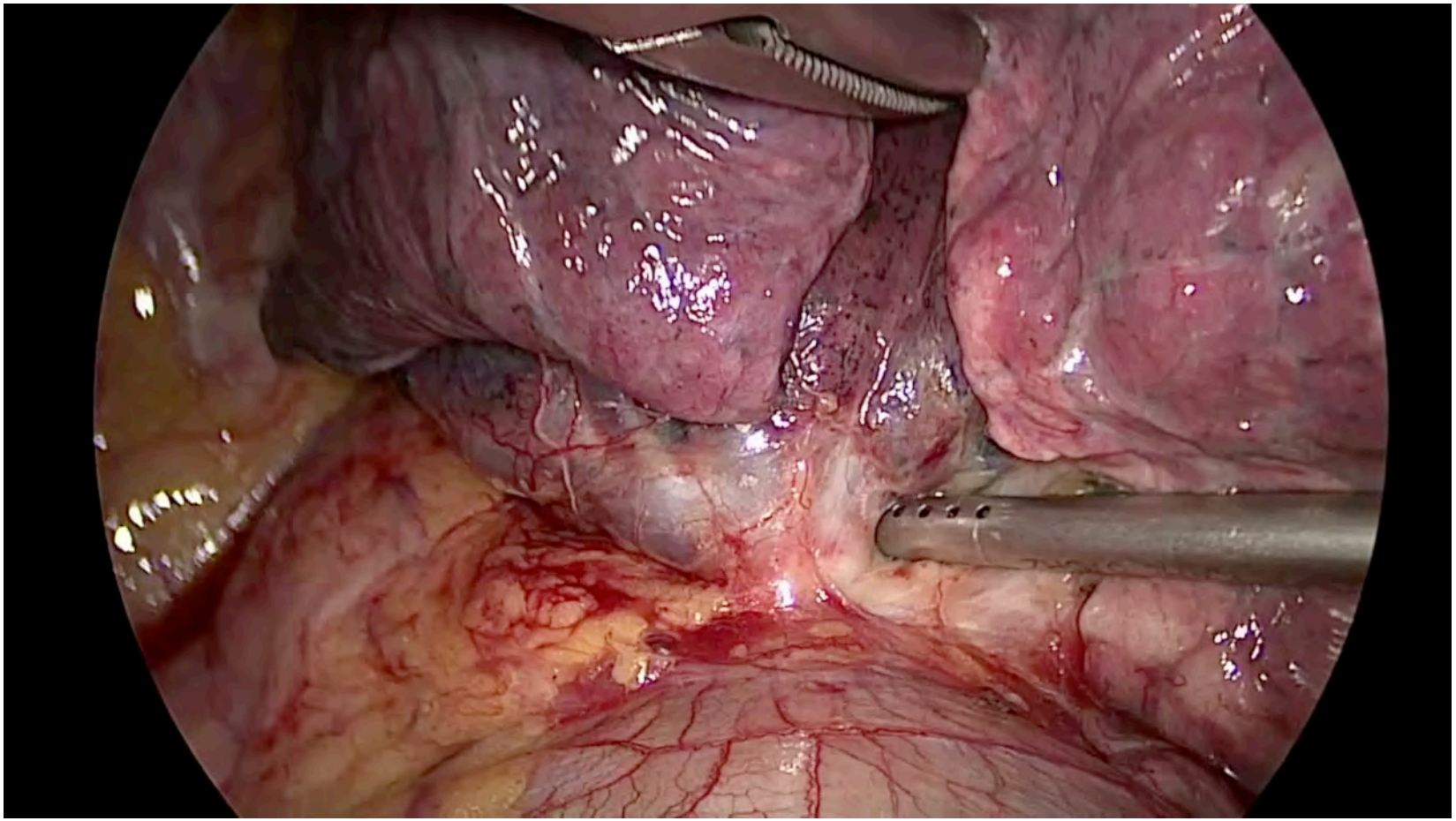

Lower Lobe
Upper Lobe
Diaphragm
Upper Lobe Vein
X
Lower Lobe Vein
PA
Pericardium
Phrenic Nerve


Upper Lobe
Lingular Artery
Upper Lobe Bronchus
Upper Lobe Vein
X
Basal Segment Artery
Lower Lobe Bronchus
Lower Lobe Vein

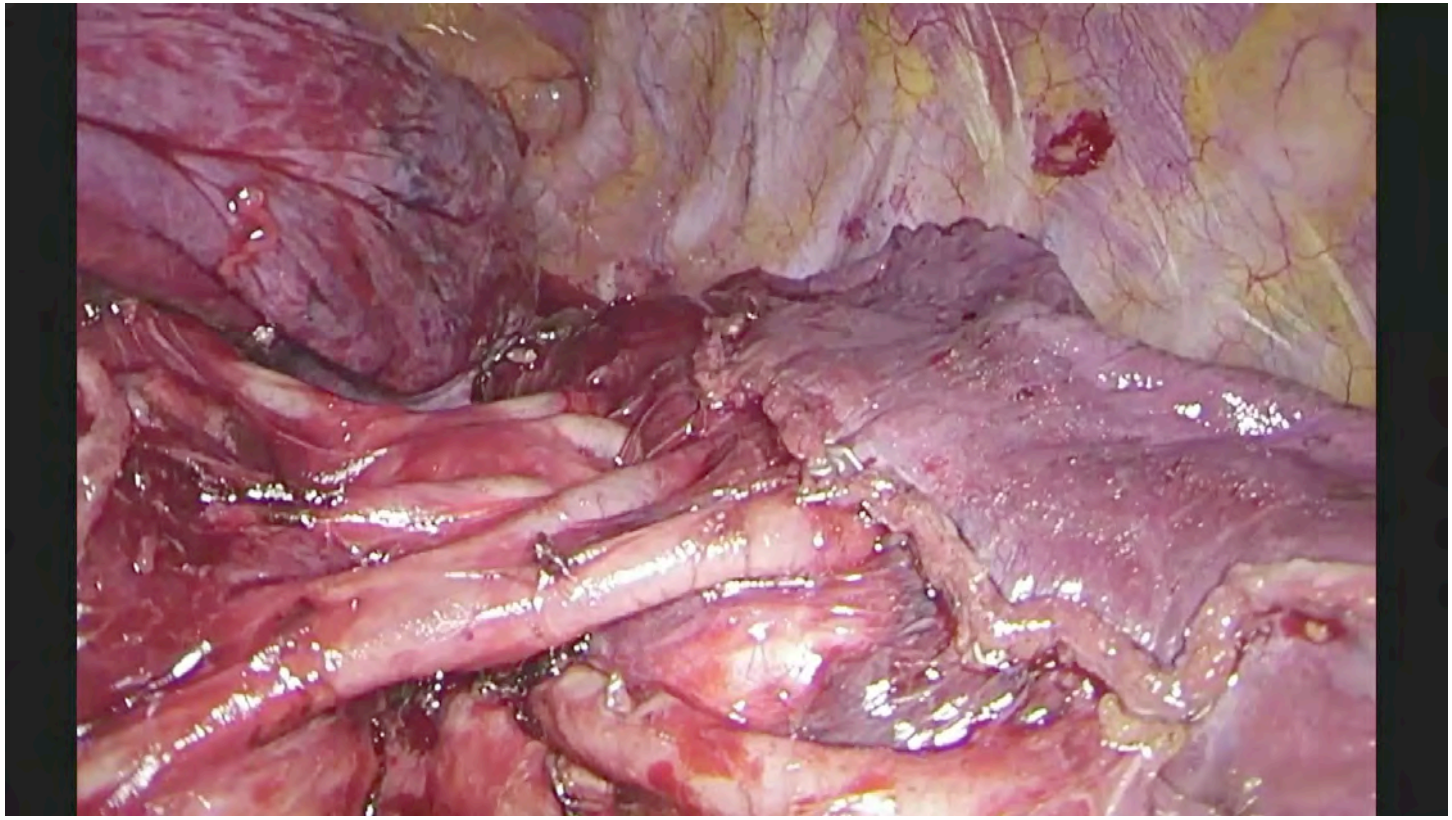

Upper Lobe
a2
Lingular Artery
Upper Lobe Vein
Lower Lobe
a6
Basal Segment Arteries
Lower Lobe Vein


Left Upper Lobe
S6 Artery
Left lower Lobe
Lingular Artery
Basal Segmental Artery
LLL Bronchus
LLL Vein





# ‘crazy’ fissure



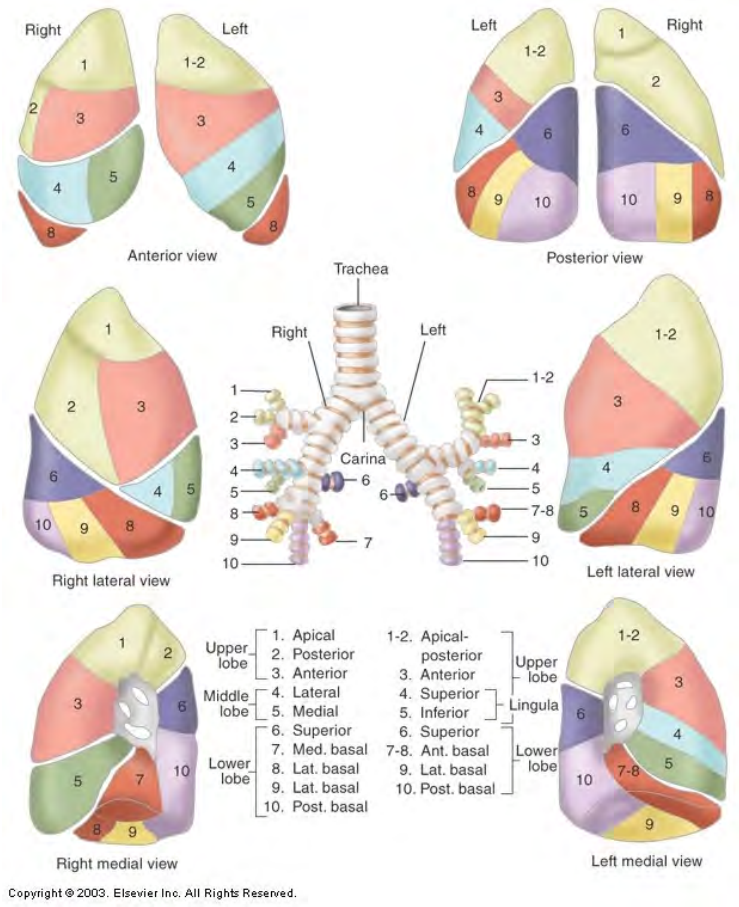
# Segmentectomies

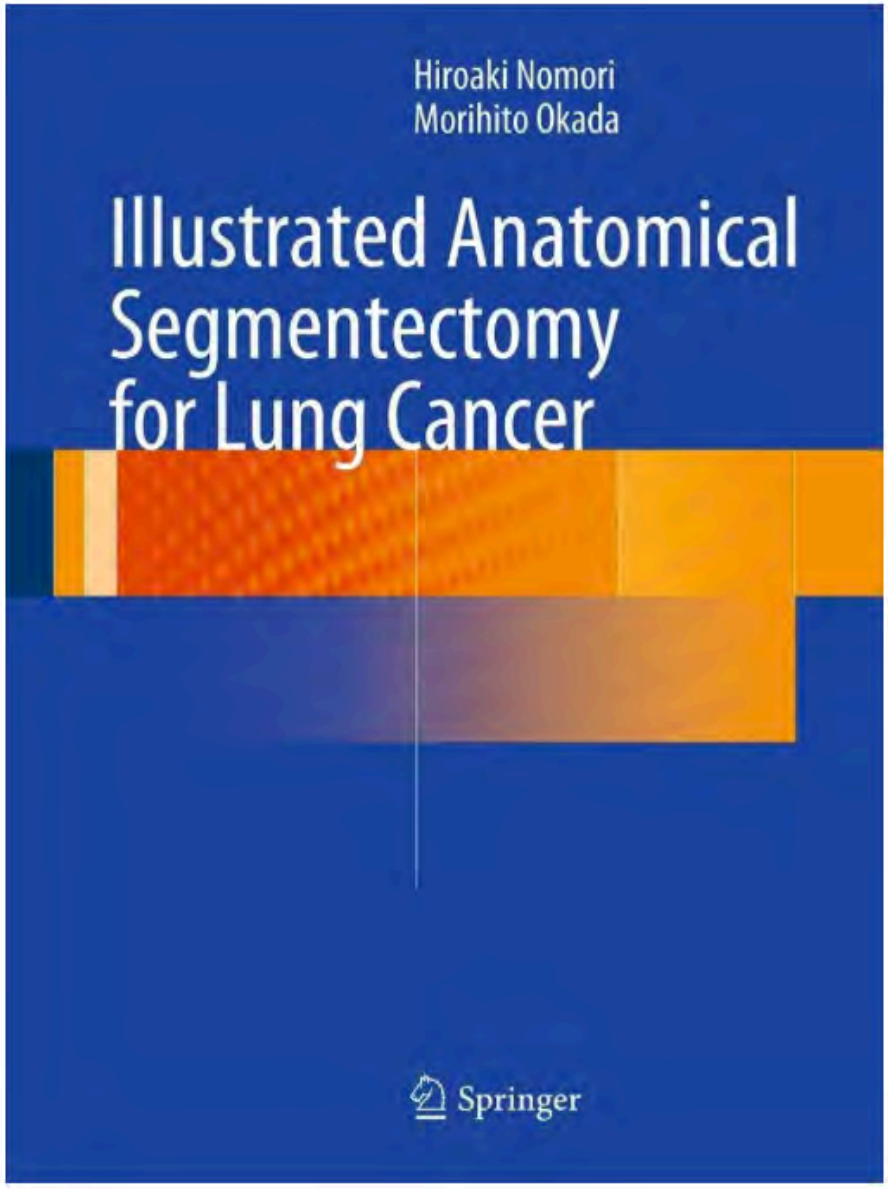
# Segmentectomy

Easy:
S 6
S 1-3 left (culmen / trisegmentectomy/ lingulasparing lobectomy)
S 4-5 left (lingula)
S6 sparing lobectomy

Moderate:
Apicodorsal 1+2
Individual S1/2/3
(Individual segments S4/5)
Anteromedial basal segments lower lobe

Hard:
Individual (lateral) basal segments S7-10



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# Thoracoscopic Right Apicoposterior Segmentectomy

Wednesday, November 15, 2017

By **Dominique Gossot, Agathe Seguin, Madalina Grigoroiu, Emmanuel Brian, Akram Traibi**

Gossot, Dominique; Sequin-Givelet, Agathe; Grigoroiu, Madalina; Brian, Emmanuel; Traibi, Akram (2017): Thoracoscopic Right Apicoposterior Segmentectomy.
CTSNet, Inc. **https://doi.org/10.25373/ctsnet.5566726**
Retrieved: 19:43, Nov 15, 2017 (GMT)

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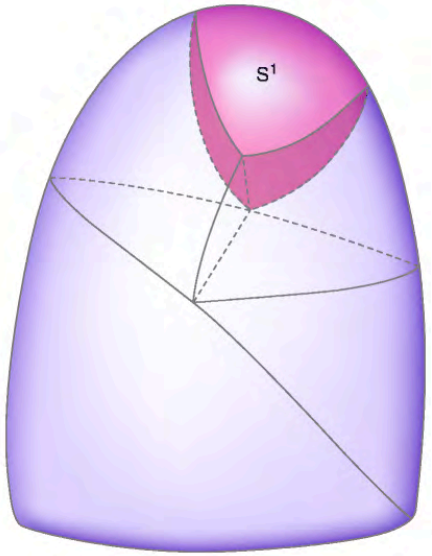
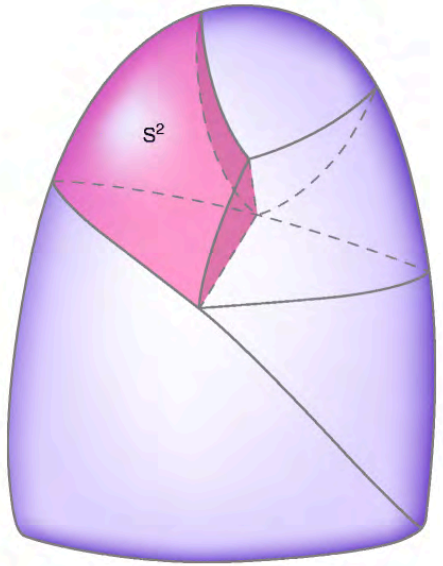
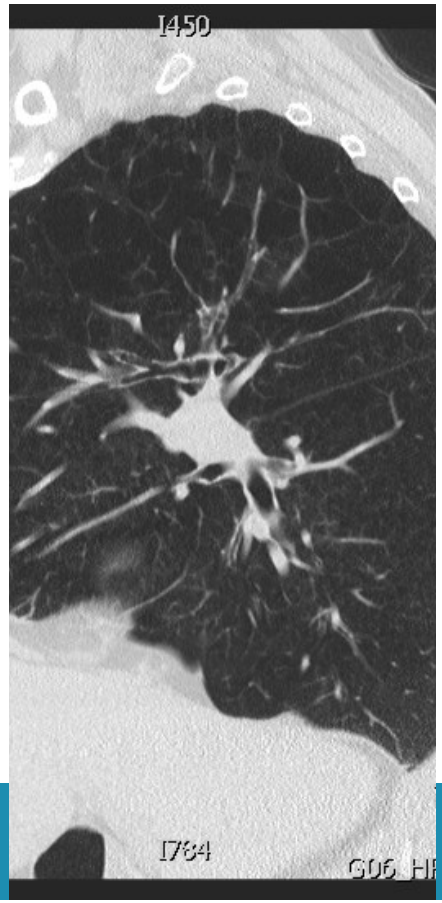
# Right
# S1-S2

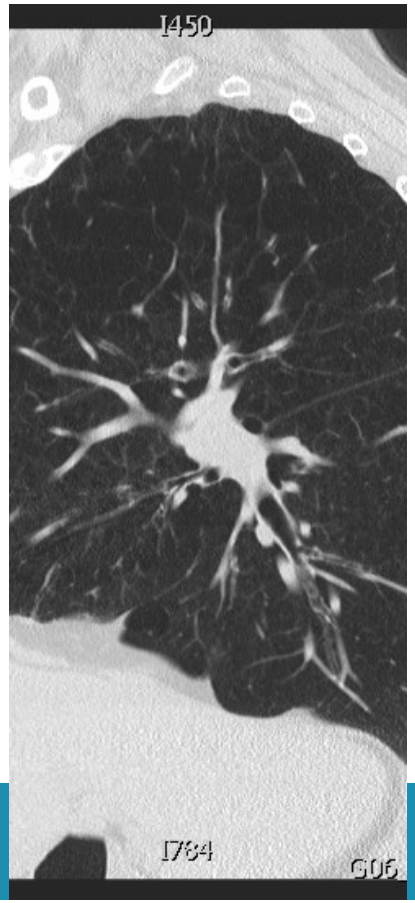


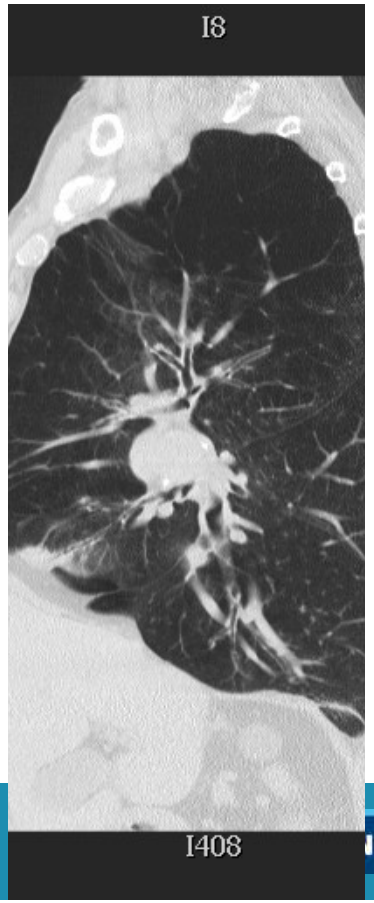
# Bronchus

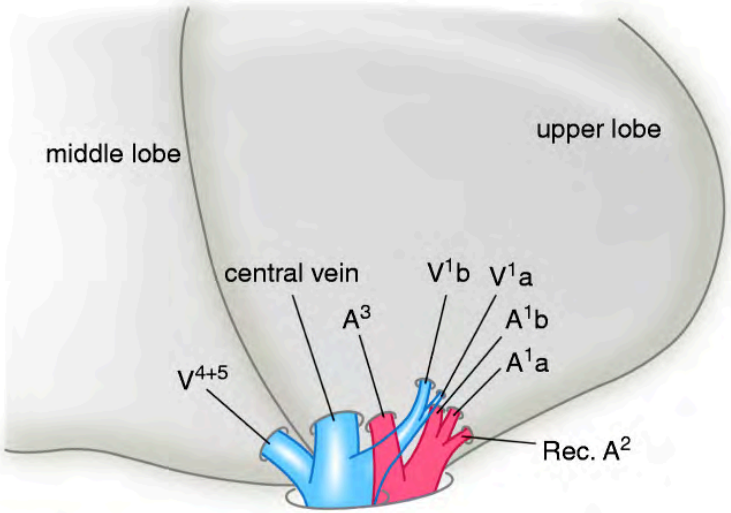
## B1 + B2 + B3



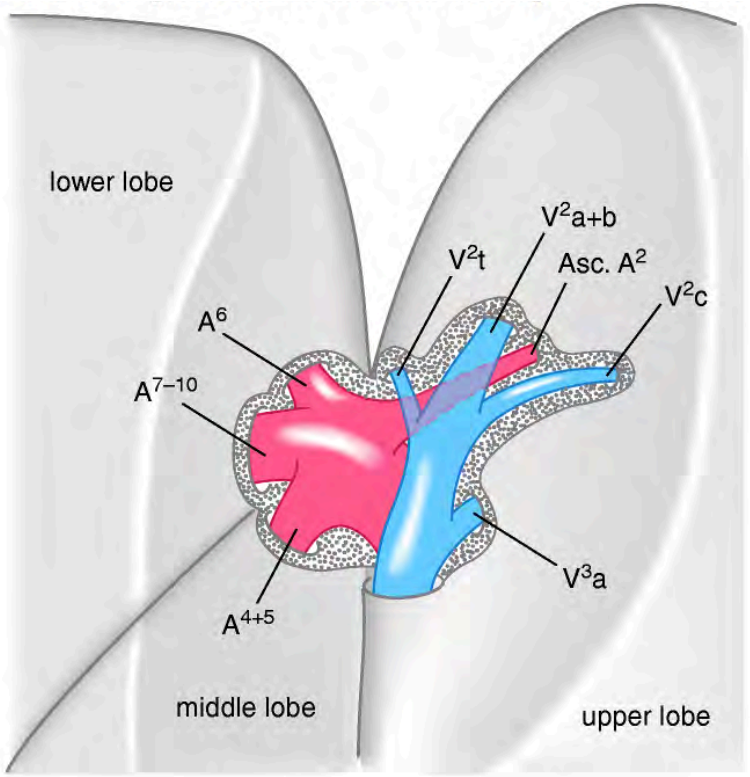




## B1-2 + B3




Anterior view

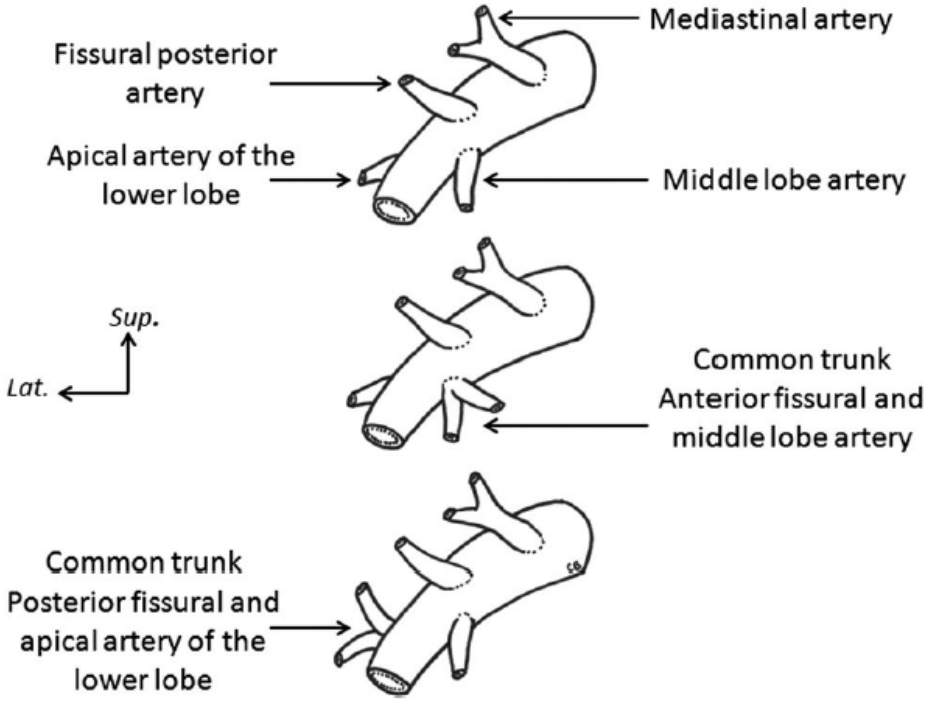



Lateral View

# Right Upper Lobe: Artery

**Three-dimensional CT angiography of anatomic variations in the pulmonary arterial tree**

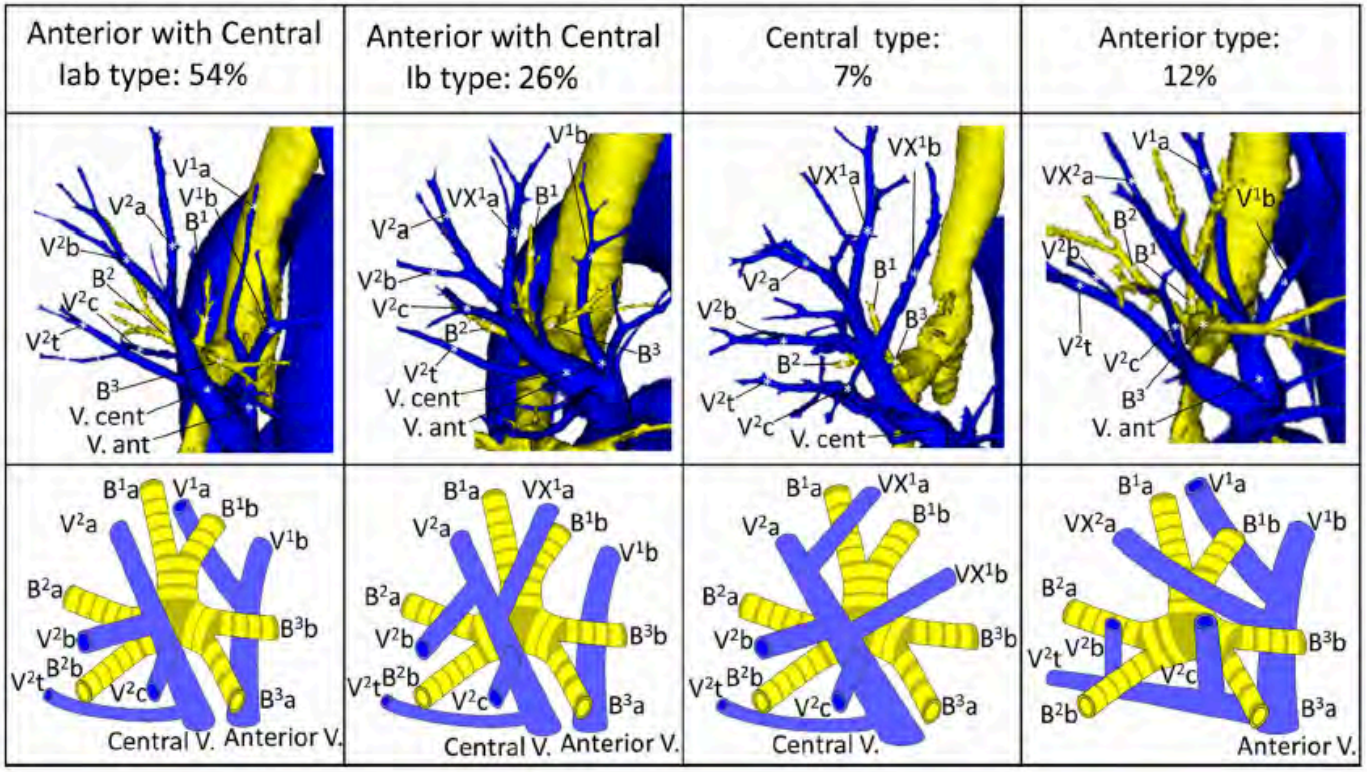
Alex Fourdrain[1,2] · Florence De Dominicis[1] · Chloé Blanchard[1] · Jules Iquille[1] · Sophie Lafitte[1] · Pierre-Louis Beuvry[1] · David Michel[3] · Geoni Merlusca[1] · Eric Havet[2] · Pascal Berna[1]



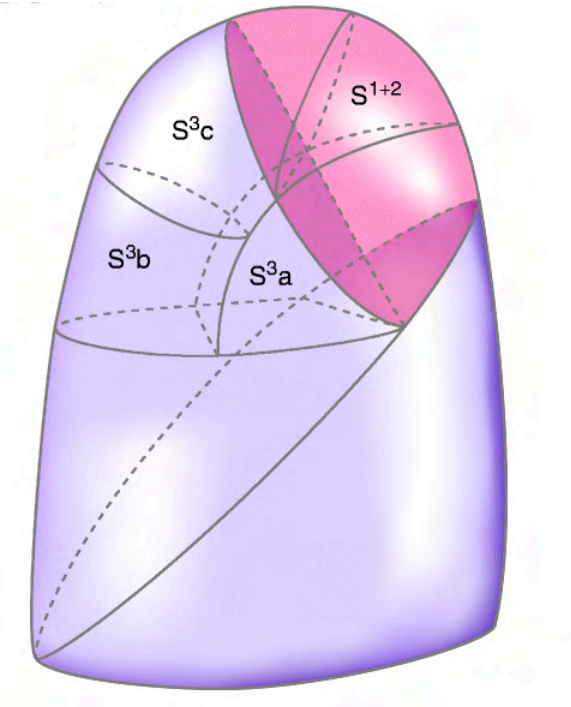
# Right Upper Lobe: Veins

**Analysis of the variation pattern in right upper pulmonary veins and establishment of simplified vein models for anatomical segmentectomy**

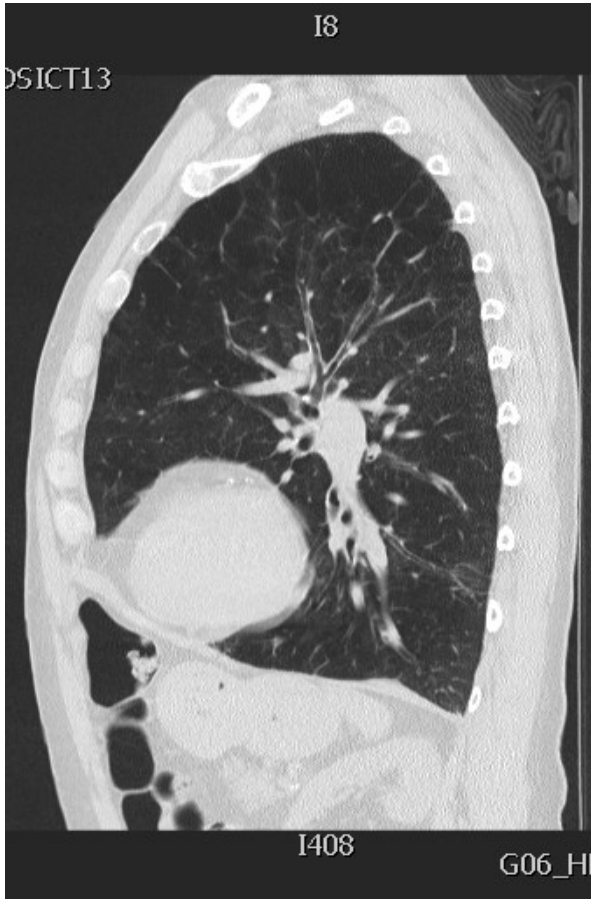
Kimihiro Shimizu[1,2] · Toshiteru Nagashima[1,2] · Yoichi Ohtaki[1,2] · Kai Obayashi[1,2] · Seshiru Nakazawa[1,2] · Mitsuhiro Kamiyoshihara[2,3] · Hitoshi Igai[3] · Izumi Takeyoshi[2] · Akira Mogi[1] · Hiroyuki Kuwano[1]



# Left



# Bronchus




B1-2 + B3

# Pulmonary artery left upper lobe

*Thorax* (1959), **14**, 267.

## VARYING PATTERNS OF THE LOBAR BRANCHES OF THE PULMONARY ARTERY

### A STUDY OF 524 LUNGS AND LOBES SEEN AT OPERATION ON 426 PATIENTS

BY

RICHARD A. S. CORY AND EDWARD J. VALENTINE

*ge V Jubilee Memorial Sanatorium, Liguanea, Jamaica, W.I.*

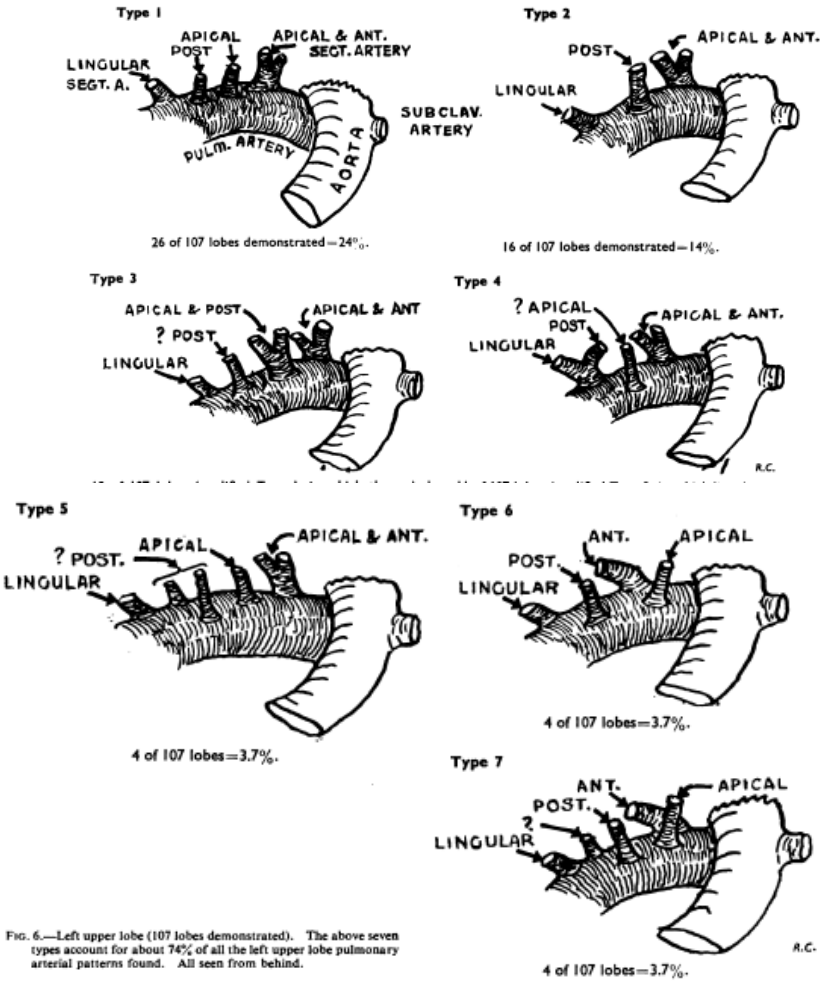



FIG. 6.—Left upper lobe (107 lobes demonstrated). The above seven types account for about 74% of all the left upper lobe pulmonary arterial patterns found. All seen from behind.

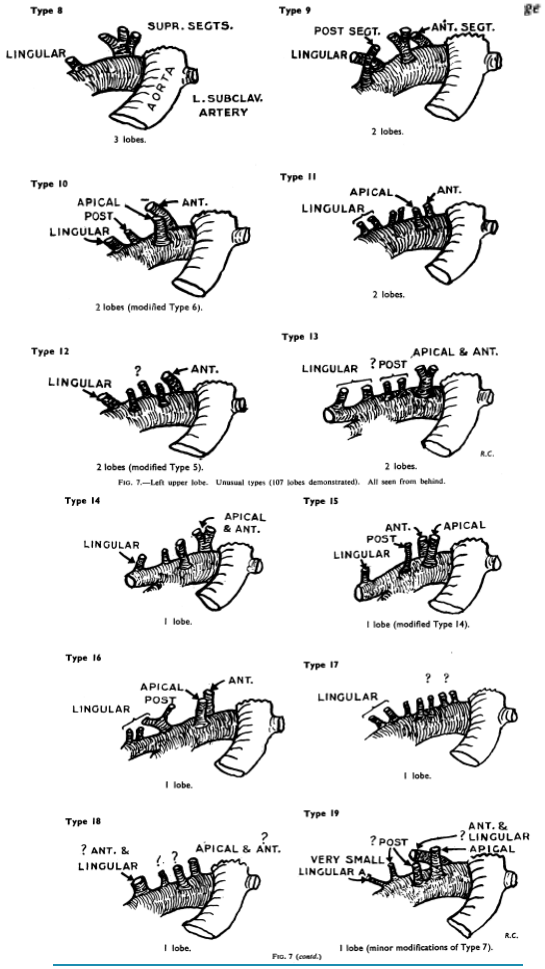



FIG. 7.—Left upper lobe. Unusual types (107 lobes demonstrated). All seen from behind.

FIG. 7 (contd.)

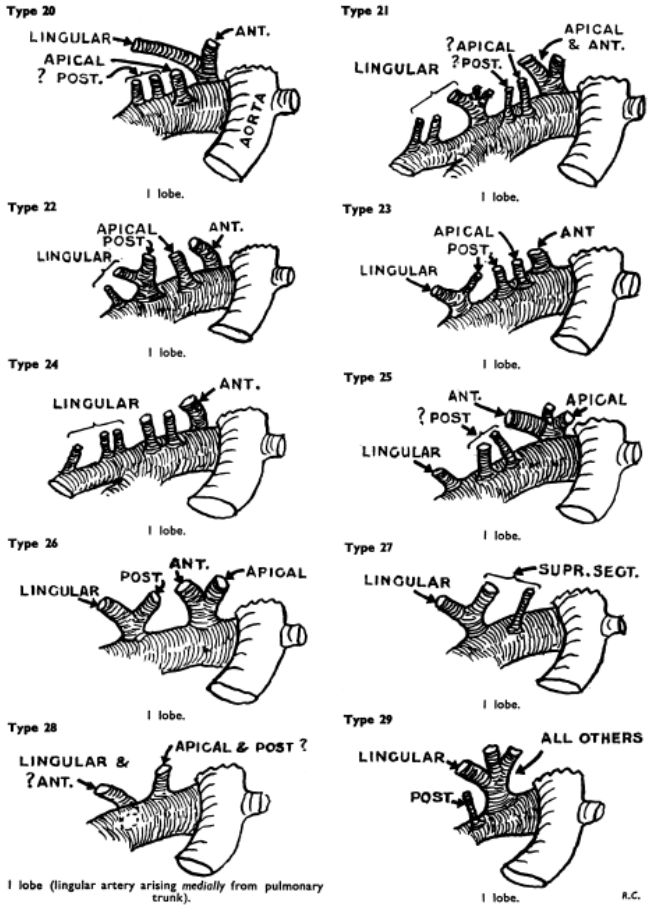
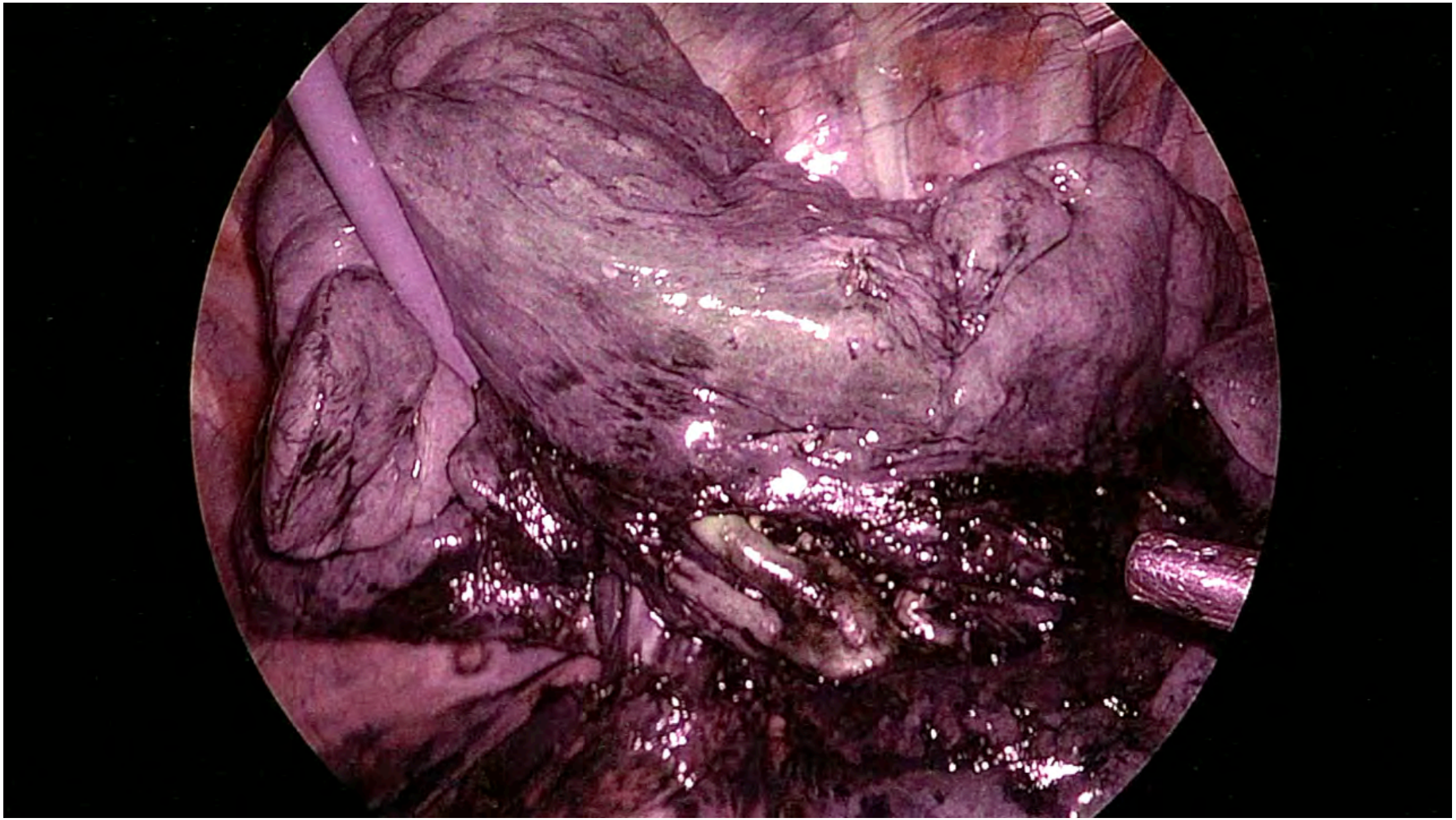


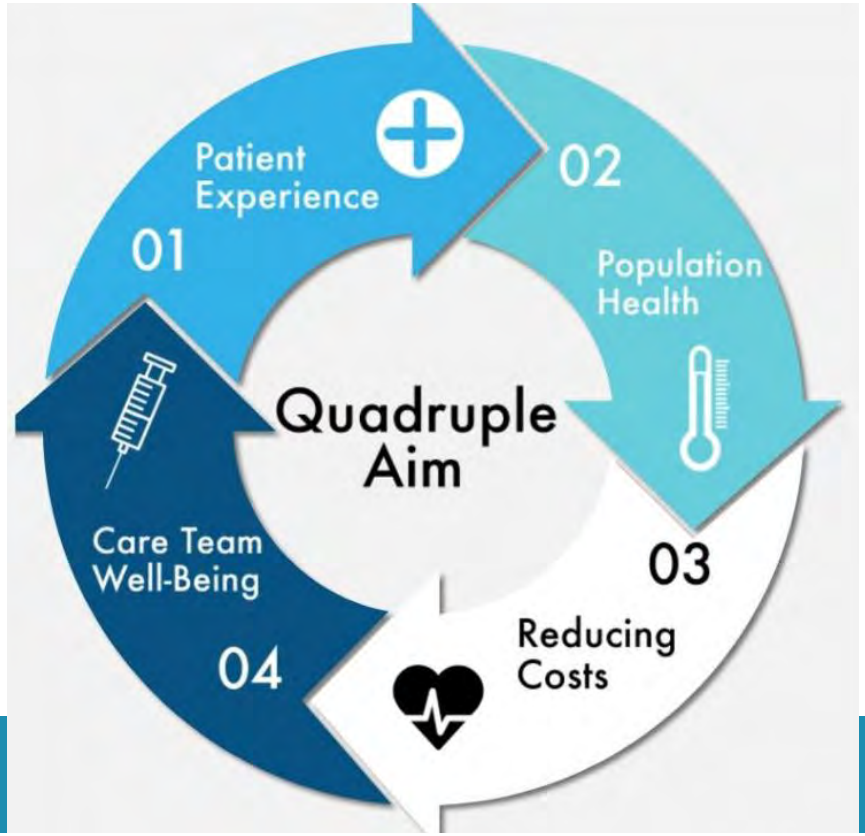

FIG. 8.—Left upper lobe (107 lobes demonstrated). All seen from behind.



# Sleeve resection

- Uniportal Sleeve
- RATS Sleeve
- RATS Sleeve left main bronchus without parenchymal resection
- RATS ML sleeve


VALUE
=
Quality
Cost
=
Outcomes +
Patient Experience
Direct Costs +
Indirect Costs


Patient
Experience
01
02
Population
Health
Quadruple
Aim
Care Team
Well-Being
04
03
Reducing
Costs

# Uniportal vs RATS

| | |
|---|---|
| Cheaper | More technically demanding * |
| Faster * | Less ergonomic * |
| Only one port | Suturing remains a pain * |
| Enhanced recovery | Stapler angle of attack is limited * |
| Less morphine (?) | Delicate dissection easier with robot * |
| Close Patient contact – safety | ‘Advanced instrumentation’ = suction in left hand – dissector right hand |
| Allows hybrid procedures | Some report better lymphadenectomy with robot * |
| Modern dissector-sealer (ligasure - | |

* significantly operator and team dependent

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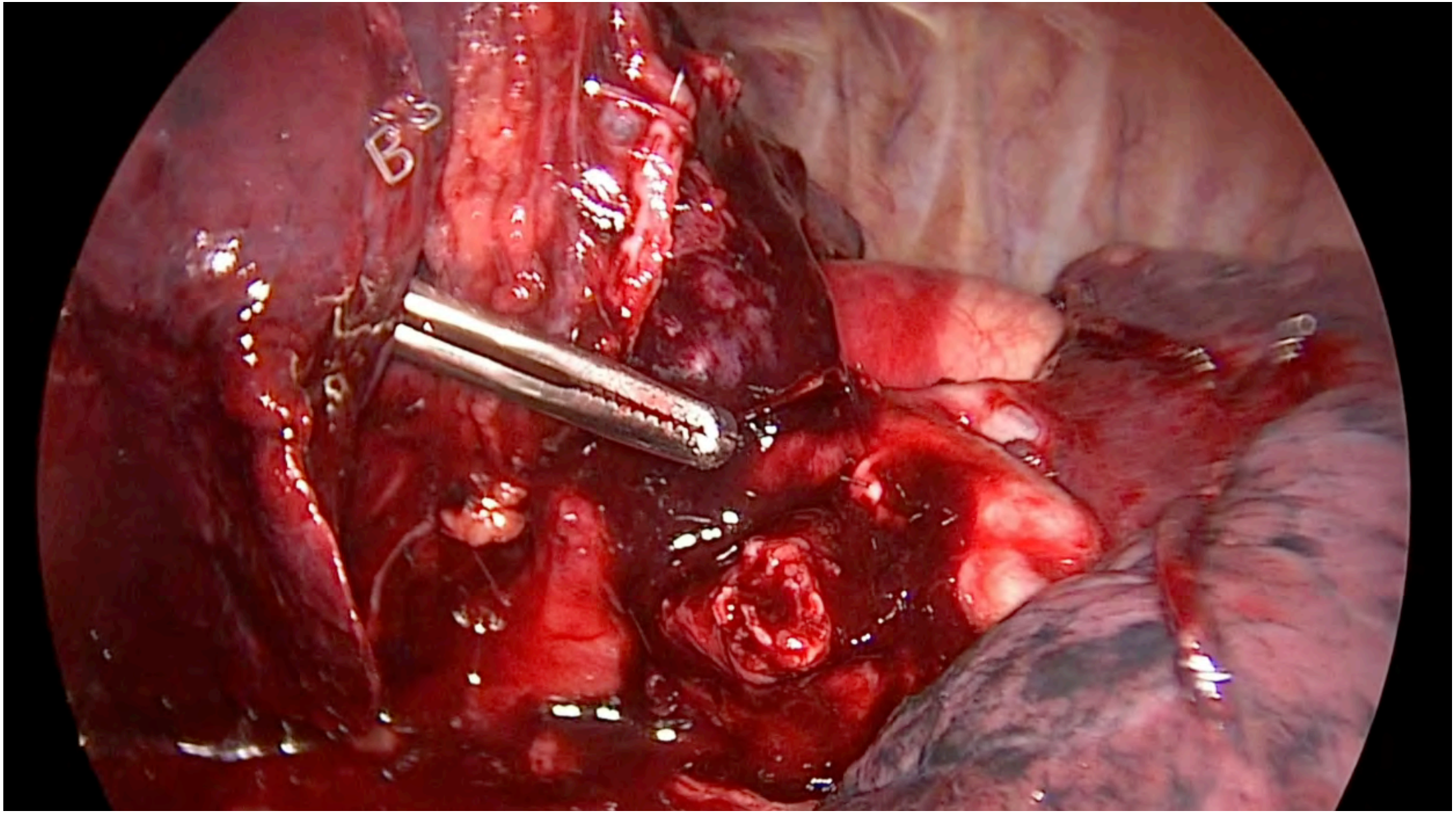
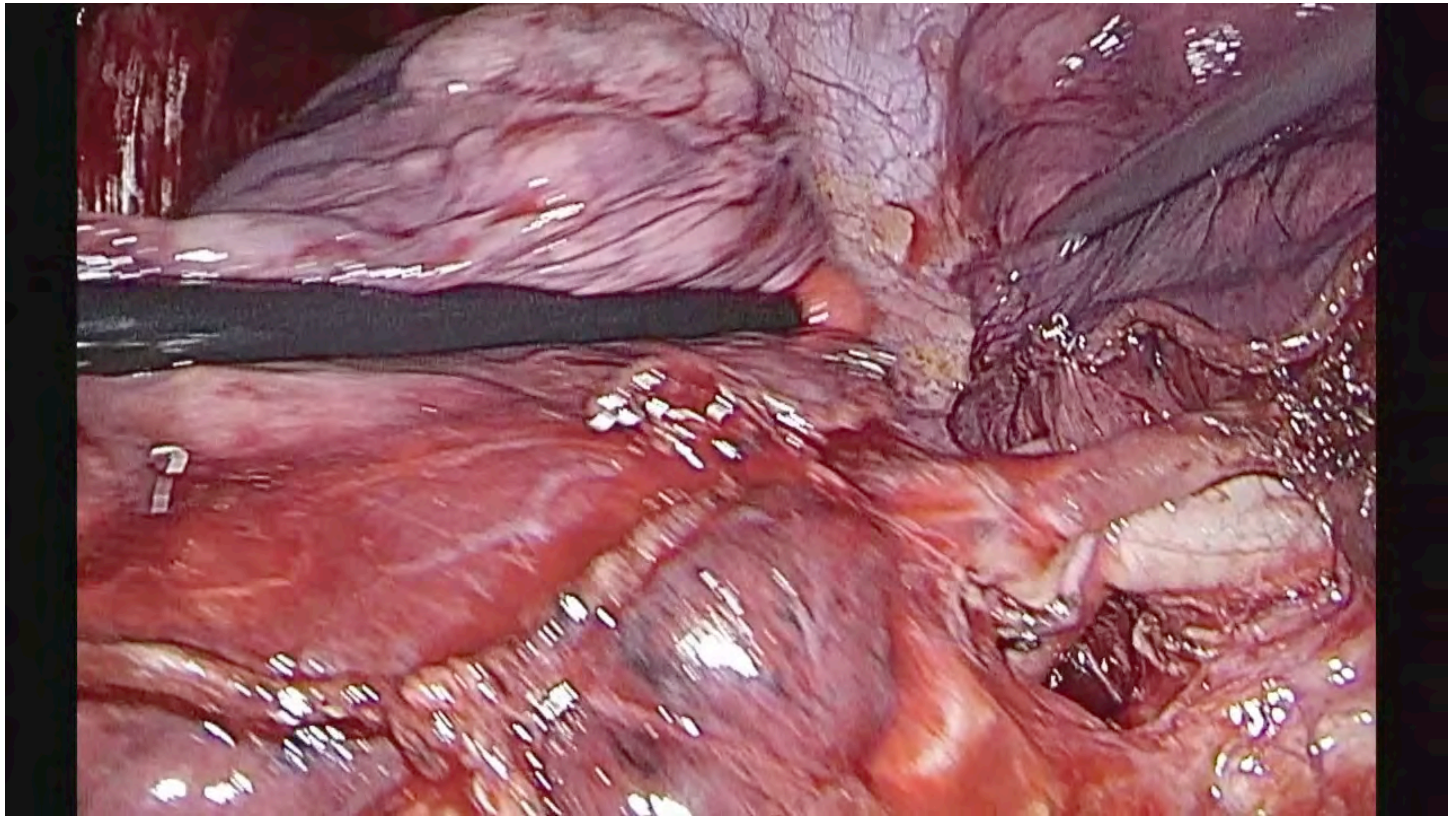
# Avoiding Major Complications



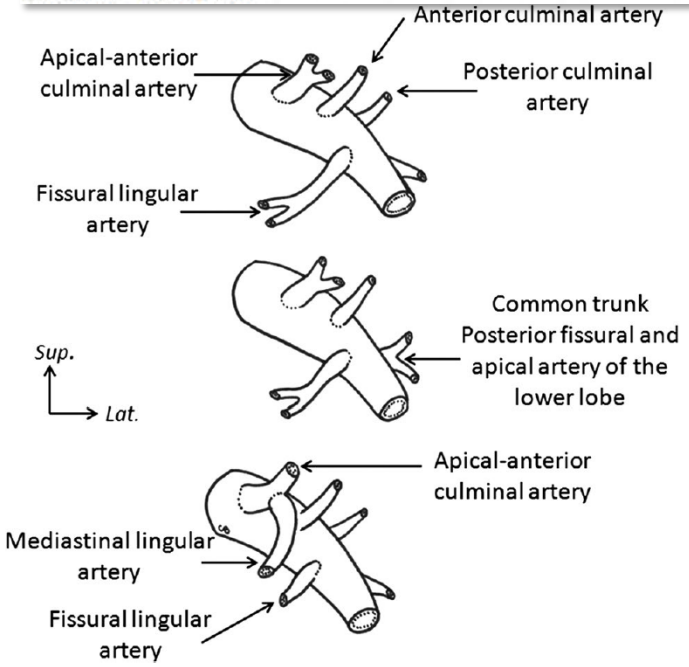
# Basal artery from lingular artery



# Pulmonary artery left upper lobe

**Three-dimensional CT angiography of anatomic variations in the pulmonary arterial tree**

Alex Fourdrain[1,2] · Florence De Dominicis[1] · Chloé Blanchard[1] · Jules Iquille[1] · Sophie Lafitte[1] · Pierre-Louis Beuvry[1] · David Michel[3] · Geoni Merlusca[1] · Eric Havet[2] · Pascal Berna[1]




**Potentially overlooked branches of the left pulmonary artery**

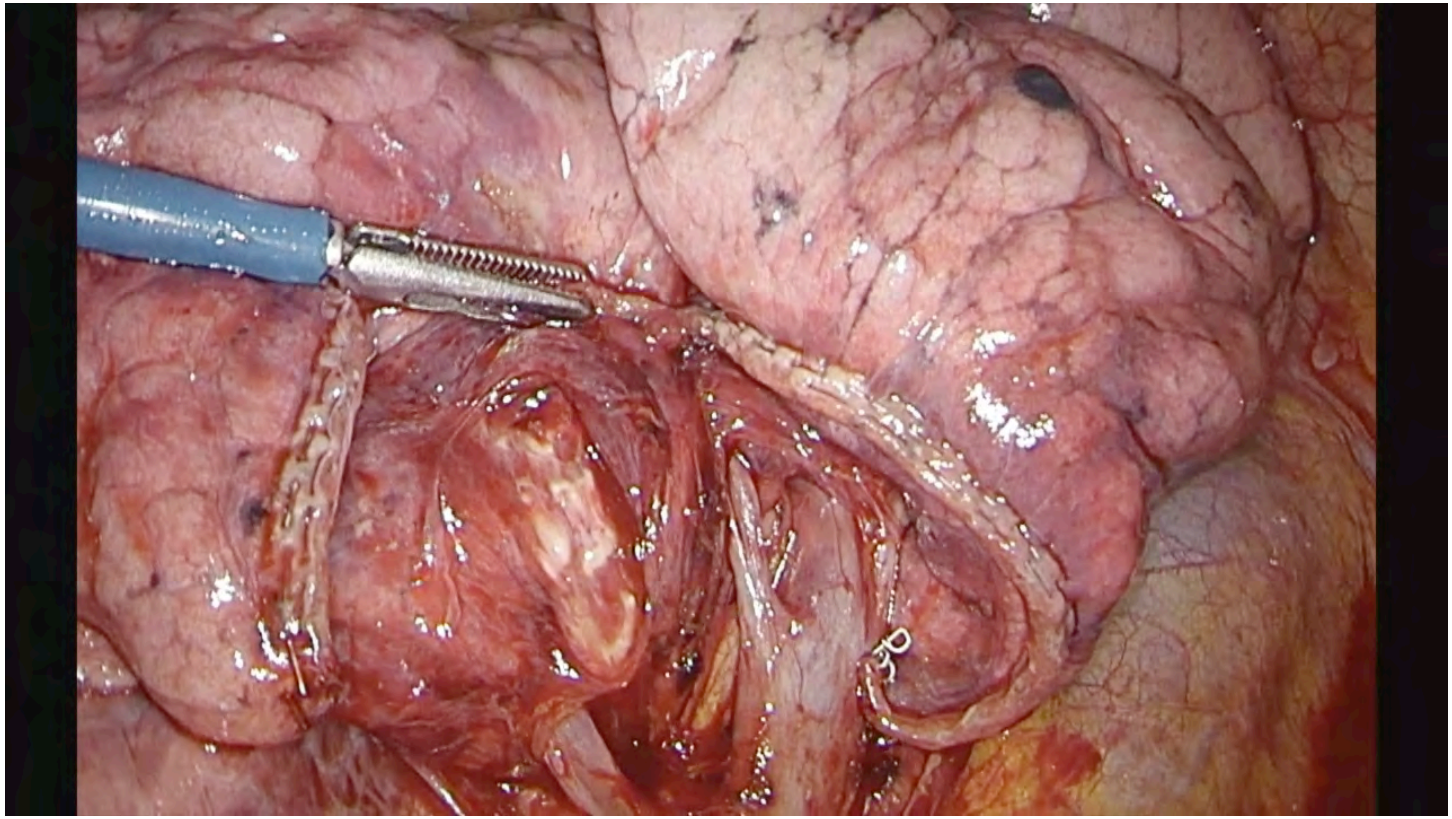
Asian Cardiovascular & Thoracic Annals
2016, Vol. 24(7) 676–680

DOI: 10.1177/0218492316660452
aan.sagepub.com
SAGE

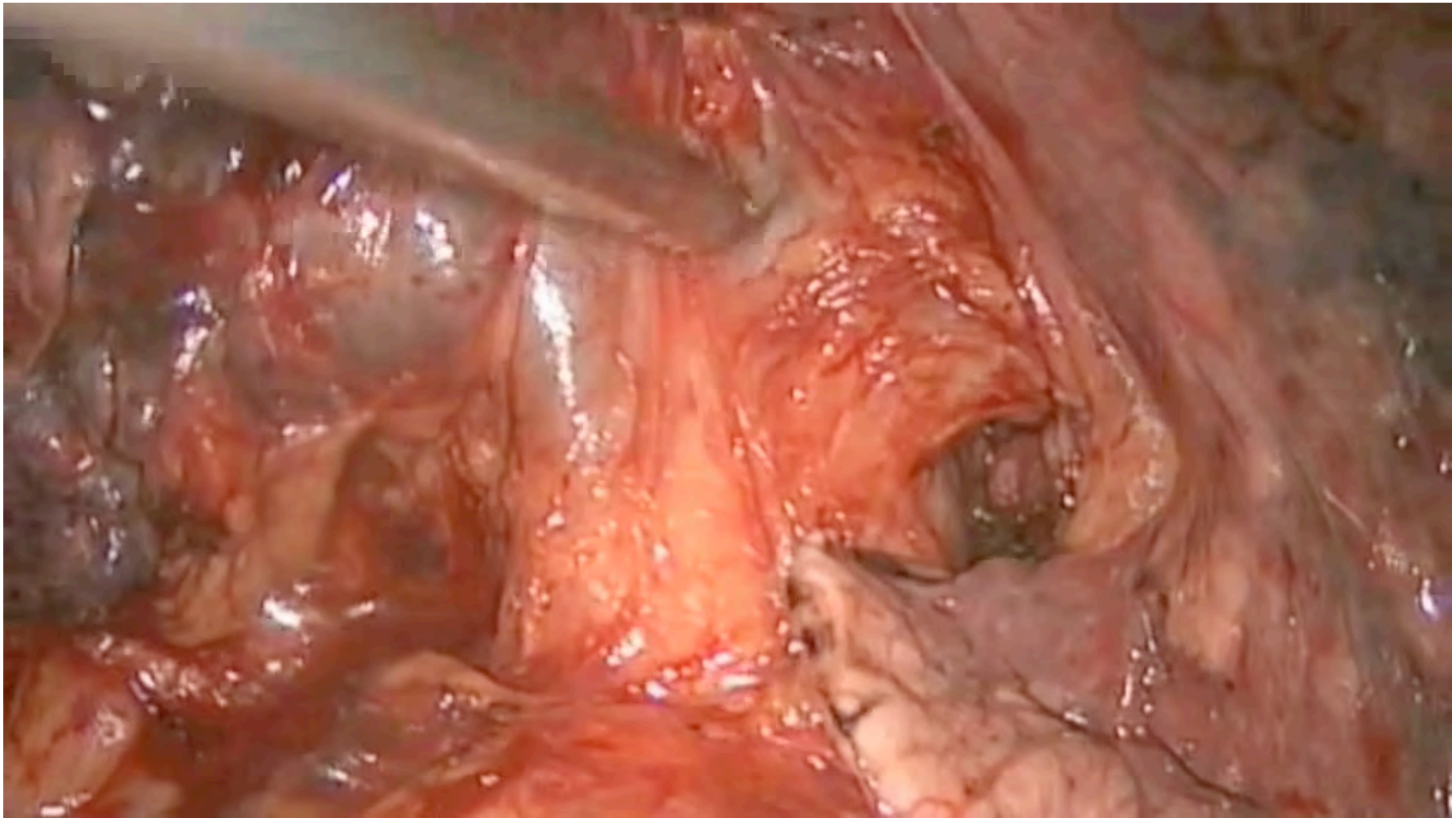
Toshiyuki Nagata, Yoshihiro Nakamura, Kota Kariatsumari, Tsunayuki Otsuka, Masaya Aoki and Masami Sato

33% lingular artery (partially) from mediastinal artery

# Middle lobe vein to upper lobe vein



# Middle lobe artery from basal segm artery



# Frequent anatomical variants:

- Early confluens of veins
- Middle lobe vein draining into lower vein
- A2 RUL vs A6 RLL
- Lingula artery from truncal artery
- Lingula artery from basal segmental artery
- Segment 6 bronchus more proximal than middle lobe bronchus

European Journal of Cardio-Thoracic Surgery 48 (2015) 588–599
doi:10.1093/ejcts/ezv287

**ORIGINAL ARTICLE**

Cite this article as: Decaluwe H, Petersen RH, Hansen H, Piwkowski C, Augustin F, Brunelli A *et al*. Major intraoperative complications during video-assisted thoracoscopic anatomical lung resections: an intention-to-treat analysis. Eur J Cardiothorac Surg 2015;48:588–99.

# Major intraoperative complications during video-assisted thoracoscopic anatomical lung resections: an intention-to-treat analysis†

Herbert Decaluwe[a,b,*], René Horsleben Petersen[c], Henrik Hansen[c], Cezary Piwkowski[d], Florian Augustin[e], Alessandro Brunelli[f], Thomas Schmid[e], Kostas Papagiannopoulos[f], Johnny Moons[a,b] and Dominique Gossot[g], on behalf of the ESTS Minimally Invasive Thoracic Surgery Interest Group (MITIG)

UZ LEUVEN

REGION H Rigshospitalet

GHMF L'INSTITUT MUTUALISTE MONTSOURIS

St James's University Hospital

PUMS Poznan University of Medical Sciences

Medizinische Universität Innsbruck

KU LEUVEN

# Major intraoperative complications

Overall: 1.5% **n=46/3076**

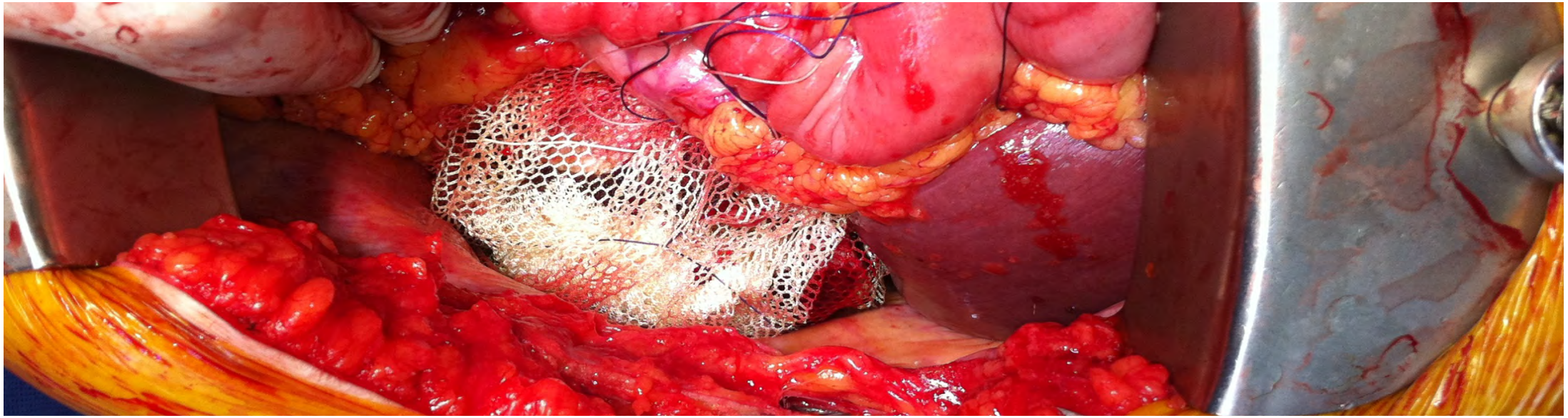
| | |
|---|---|
| Erroneous transection of bronchovascular structure | n=9 |
| Injury to GI organ | n=5 |
| Injury to proximal airway | n=6 |
| Complications requiring additional major surgery | n=9 |
| Immediate life-threatening complications | n=17 |

## Impact on outcome:

| | | |
|---|---|---|
| Additional anatomical resection (incl. 8 pneumonectomies) | | n=18 |
| Overall in-hospital mortality | 1.4% | n= 43/3076 |
| of whom related to MIC | 23% | n=10/43 |

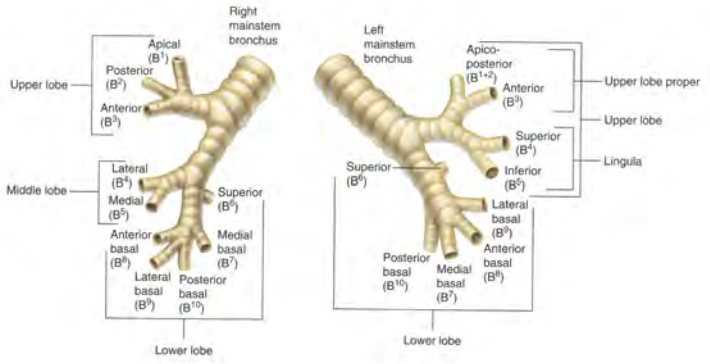
# Injuries to GI organs (n=5)

- Esophageal perforation (n=4)
  - Stapled with posterior part of fissure (n=1)
  - Monopolar coagulation (delayed) (n=3)
- Spleen bleeding (n=1)



# Injuries to proximal airway (n=6)

- DLT perforation (n=3)
  - Hyperinflation
  - DLT retracted with inflated balloon
  - Small scar at level balloon during subcarinal lymphadenectomy resulting in full tear
- Operative tear of intermediate bronchus (n=3)

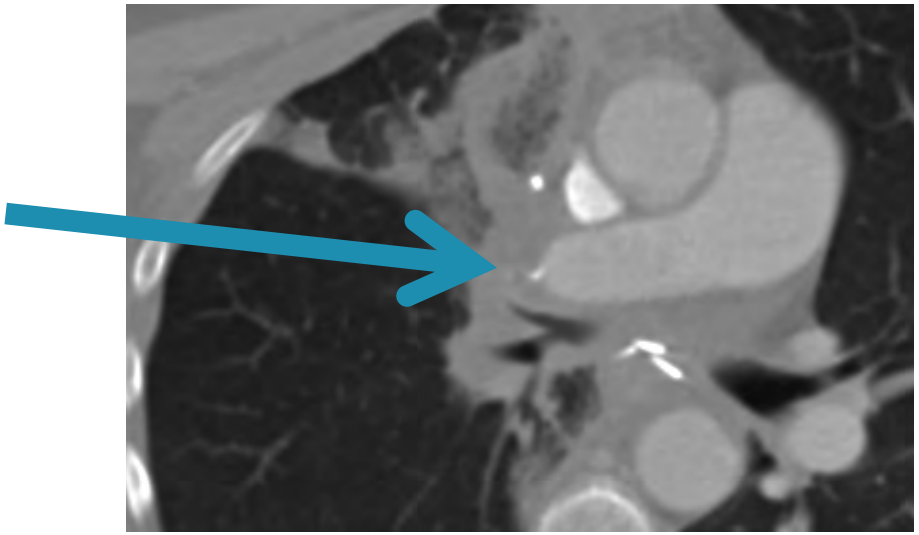


# Erroneous transection of bronchovascular structures (n=9)

**Artery**

**PA** or lower part PA together with ULV

during right upper lobectomy (n=3)



**Veins**

- **Both veins** during left upper lobectomy (n=1)
- MLV with ULV (n=2)
- Transection of lingular vein during upper trisegmentectomy (n=1)

**Bronchus**

Intermediate bronchus instead of ULBr or LLBr (n=2)

# Immediately life threatening complications (n=17)

Ventricle fibrillation (n=1)

Cardiac perforation (n=1)

Bleeding >2l or only controllable by pneumonectomy (n=15)

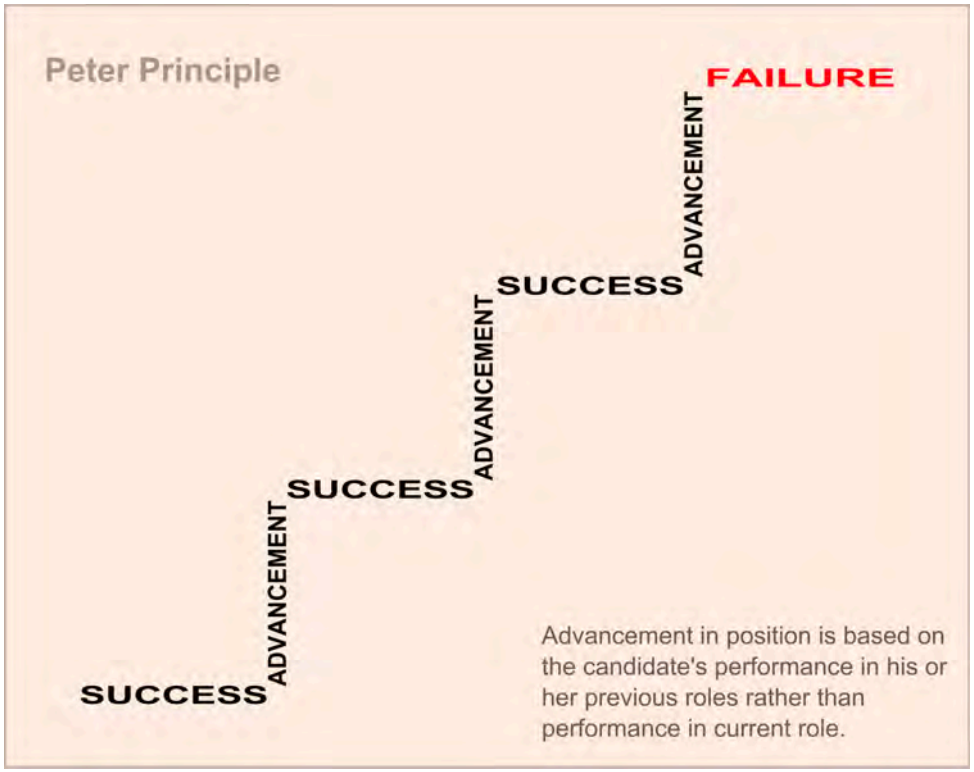
- Emergency pneumonectomies (n=5)
- Intraoperative deaths (n=3)
- Death in recovery (n=1)
- In-hospital mortality (n=6)
- 90D mortality (n=7)

| | Major complication | M/F | Age | pSt | Planned resect. | Surg's exp | VATS index | Mechanism of complication contributing factors | Conv | Treatment | Add. resect. | Hosp stay | IHM | 90DM |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31 | Cardiac perforation | F | 75 | IA | Segm | 200+ | 0.4 | CTh, Cardiac perf. trocart tip, | Yes | Cardiac surgeon ass, no repair possible | No | 0 | Yes | Yes |
| 32 | Sudden peroperative bleeding of more | M | 63 | IIA | RUL | 200+ | 0.8 | Probably missed diagnosis PHT | Yes | PA ruptured when clamping (after conversion) | NA | 0 | Yes | Yes |
| 33 | than 2 l or bleeding only controllable | F | 63 | IB | RUL | 200+ | 0.8 | CTh, probably missed diagnosis PHT | Yes | Repair, pneumonectomy | Yes | 17 | No | No |
| 34 | by emergency pneumonectomy | F | 68 | IIA | LLL | 200+ | 0.8 | Rupture PA stump in recovery, folded artery | No | Repair unsuccessful | No | 0 | Yes | Yes |
| 35 | | F | 78 | IA | RUL | 200+ | 0.8 | Lesion A2, failed attempt at VATS suture | Yes | Clamp, repair, cardiac massage | No | 0 | Yes | Yes |
| 36 | | F | 54 | IA | LUTS | 101–200 | 0.3 | Lesion A2, failed attempt at VATS suture | Yes | Clamp, repair | No | 10 | No | No |
| 37 | | M | 79 | IA | LUL | 51–100 | 0.6 | Tear when stapling superior trunk PA | Yes | Clamp, repair | No | 19 | Yes | Yes |
| 38 | | F | 67 | IA | RUM | 0–50 | 0.6 | Tear when stapling superior trunk PA | Yes | Clamp, repair (oncologic bilobectomy) | No | 22 | No | No |
| 39 | | F | 68 | IB | RLL | 200+ | 0.8 | Lesion A2 | Yes | Clamp, repair | No | 5 | No | No |
| 40 | | M | 62 | IIB | RUL | 200+ | 0.8 | Lesion A2, liver cirrhosis, EF 40%, AAA | Yes | Clamp, repair | No | 8 | Yes | Yes |
| 41 | | F | 66 | IB | RUL | 200+ | 0.3 | CTh, bleeding PA | Yes | Pneumonectomy | Yes | 92 | No | No |
| 42 | | M | 55 | IIIA | RUL | 0–50 | 0.6 | Def CRT, bleeding PA | Yes | Pneumonectomy | Yes | 12 | No | No |
| 43 | | M | 66 | IIA | LLL | 51–100 | 0.8 | Fragile PA, infiltrating tumour and nodes | Yes | Pneumonectomy | Yes | 15 | No | No |
| 44 | | M | 82 | IA | LLL | 200+ | 0.8 | Unknown | Yes | Repair | No | 22 | No | Yes |
| 45 | | F | 72 | IIIA | LLL | 200+ | 0.8 | Lower lobe PA tear when applying stapler | Yes | Clamp, repair | No | 10 | No | No |
| 46 | | M | 74 | IIB | LUL | 0–50 | 0.9 | Fragile PA, infiltrating nodes | Yes | Pneumonectomy | Yes | 18 | No | No |

# Multivariate logistic regression

| | | Non-oncologic Conversions | | Major intraoperative complications | |
|---|---|---|---|---|---|
| | | **Odds ratio (95%CI)** | **P-value** | **Odds ratio (95%CI)** | **P-value** |
| Surgical experience (10 surgeries) | | 0.976 (0.965;0.986) | **<.0001** | 0.997 (0.983;1.012) | 0.7299 |
| Gender | Female | 0.813 (0.568;1.163) | 0.2563 | 1.488 (0.820;2.700) | 0.1912 |
| Age | | 1.013 (0.995;1.032) | 0.1553 | 1.024 (0.993;1.057) | 0.1287 |
| Side | Left | 0.706 (0.488;1.021) | 0.0646 | 0.856 (0.467;1.570) | 0.6159 |
| Pathology | | | 0.1751 | | 0.9766 |
| | Advanced tumor | 3.058 (0.707;13.235) | 0.1347 | 1.394 (0.168;11.574) | 0.7585 |
| | Early tumor | 1.999 (0.479;8.343) | 0.3418 | 1.522 (0.203;11.395) | 0.6824 |
| | Metastasis | 1.913 (0.385;9.516) | 0.4279 | 0.000 (0.000;19E254) | 0.9682 |
| | Benign | # | . | # | . |
| CTx or RTx | Yes | 2.129 (1.089;4.162) | **0.0271** | 4.631 (1.859;11.536) | **0.0010** |

# Beyond the LC…
# the Generalized Peter Principle?




“selection of a candidate for a position is based on the candidate's performance in their current role, rather than on abilities relevant to the intended role”

"managers rise to the level of their incompetence”

Generalized:

“Anything that works will be used in progressively more challenging applications until it fails”

# Major Bleeding 0.5%

(emergency pneumonectomy or sudden bloodloss>2L)

median VATS index

Major bleeding n=16 0.82 (IQR 0.57–0.83)

No bleeding n=3050 0.62 (IQR 0.34–0.83) p = 0.0085

“ Risk of major bleeding rose when surgeons were less selective and more willing to start major operations by VATS ”

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# Convert to Thoracotomy

No view

Doubt concerning indication for vats pneumonectomy

'Complex sleeve'

T4 reaching into atrium, caval v, proximal a

Fibrosis pulmonary artery, need for central control

(E.g. post extensive mediastinoscopy 10R – truncus anterior adherent to RUL bronchus)

Doubt concerning completeness of resection

Incomplete lymph node dissection

(e.g. post radiotherapy)

Impossible single lung ventilation

(especially after transsection of the vein)

Uncontrollable bleeding

Failure to progress

Size of lesion necessitates thoracotomy

UZ LEUVEN

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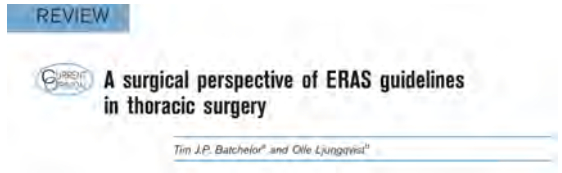
| | |
|---|---|
| En bloc lymphadenectomy | Larger tumor, high % unforeseen N2 |
| Obtaining central control (sling) | Tumor reaching first branches |
| Advanced dissection techniques | N1 disease (with or without induction) |
| Material & proficiency for bronchial anastomosis | RUL Sleeve |
| Intrapericardial vessel control | ‘small’ T3-4 tumors |
| Arterial Suturing | Double Sleeve |

# Enhanced Recovery Program

# ERAS


REVIEW

A surgical perspective of ERAS guidelines in thoracic surgery

Tim J.P. Batchelor* and Olle Ljungqvist†

- Enhanced recovery after surgery (ERAS) pathways were initially developed in colorectal surgery
- Multimodal protocols target the entire patient pathway from referral through to discharge.
- Multiple small improvements and efficiencies are adopted in an evidence-based manner by a multidisciplinary team.
- Individual care elements may not necessarily have significant benefits when studied in isolation, but their combination with other elements of the pathway is thought to have a synergistic effect [1].

1. Kehlet H, Wilmore DW. Evidence-based surgical care and the evolution of fast-track surgery. Ann Surg 2008; 248:189 – 198.

able 1: Guidelines for enhanced recovery after lung surgery: recommendations of the ERAS Society and the ESTS

| ecommendations | Evidence level | Recommendation grade |
|---|---|---|
| eoperative phase | | |
| Preadmission information, education and counselling | | |
| Patients should routinely receive dedicated preoperative counselling | Low | Strong |
| Perioperative nutrition | | |
| Patients should be screened preoperatively for nutritional status and weight loss | High | Strong |
| Oral nutritional supplements should be given to malnourished patients | Moderate | Strong |
| Immune-enhancing nutrition may have a role in the malnourished patient postoperatively | Low | Weak |
| Smoking cessation | | |
| Smoking should be stopped at least 4 weeks before surgery | High | Strong |
| Alcohol dependency management | | |
| Alcohol consumption (in alcohol abusers) should be avoided for at least 4 weeks before surgery | Moderate | Strong |
| Anaemia management | | |
| Anaemia should be identified, investigated and corrected preoperatively | High | Strong |
| Pulmonary rehabilitation and prehabilitation | | |
| Prehabilitation should be considered for patients with borderline lung function or exercise capacity | Low | Strong |
| dmission | | |
| Preoperative fasting and carbohydrate treatment | | |
| Clear fluids should be allowed up until 2 h before the induction of anaesthesia and solids until 6 h before induction of anaesthesia | High | Strong |
| Oral carbohydrate loading reduces postoperative insulin resistance and should be used routinely | Low | Strong |
| Preanaesthetic medication | | |
| Routine administration of sedatives to reduce anxiety preoperatively should be avoided | Moderate | Strong |
| rioperative phase | | |
| Venous thromboembolism prophylaxis | | |
| Patients undergoing major lung resection should be treated with pharmacological and mechanical VTE prophylaxis | Moderate | Strong |
| Patients at high risk of VTE may be considered for extended prophylaxis with LMWH for up to 4 weeks | Low | Weak |
| Antibiotic prophylaxis and skin preparation | | |
| Routine intravenous antibiotics should be administered within 60 min of, but prior to, the skin incision | High | Strong |
| Hair clipping is recommended if hair removal is required | High | Strong |
| Chlorhexidine-alcohol is preferred to povidone-iodine solution for skin preparation | High | Strong |
| Preventing intraoperative hypothermia | | |
| Maintenance of normothermia with convective active warming devices should be used perioperatively | High | Strong |
| Continuous measurement of core temperature for efficacy and compliance is recommended | High | Strong |
| Standard anaesthetic protocol | | |
| Lung-protective strategies should be used during one-lung ventilation | Moderate | Strong |
| A combination of regional and general anaesthetic techniques should be used | Low | Strong |
| Short-acting volatile or intravenous anaesthetics, or their combination, are equivalent choices | Low | Strong |
| PONV control | | |
| Non-pharmacological measures to decrease the baseline risk of PONV should be used in all patients | High | Strong |
| A multimodal pharmacological approach for PONV prophylaxis is indicated in patients at moderate risk or high risk | Moderate | Strong |
| Regional anaesthesia and pain relief | | |
| Regional anaesthesia is recommended with the aim of reducing postoperative opioid use. | High | Strong |
| Paravertebral blockade provides equivalent analgesia to epidural anaesthesia | | |
| A combination of acetaminophen and NSAIDs should be administered regularly to all patients unless contraindications exist | High | Strong |
| Ketamine should be considered for patients with pre-existing chronic pain | Moderate | Strong |
| Dexamethasone may be administered to prevent PONV and reduce pain | Low | Strong |
| Perioperative fluid management | | |
| Very restrictive or liberal fluid regimes should be avoided in favour of euvolemia | Moderate | Strong |
| Balanced crystalloids are the intravenous fluid of choice and are preferred to 0.9% saline | High | Strong |
| Intravenous fluids should be discontinued as soon as possible and replaced with oral fluids and diet | Moderate | Strong |
| Atrial fibrillation prevention | | |
| Patients taking β-blockers preoperatively should continue to take them in the postoperative period | High | Strong |
| Magnesium supplementation may be considered in magnesium deplete patients | Low | Weak |
| It is reasonable to administer diltiazem preoperatively or amiodarone postoperatively for patients at risk | Moderate | Weak |
| Surgical technique: thoracotomy | | |
| If a thoracotomy is required, a muscle-sparing technique should be performed | Moderate | Strong |

Continued

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GUIDELINES

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# Guidelines for enhanced recovery after lung surgery: recommendations of the Enhanced Recovery After Surgery (ERAS®) Society and the European Society of Thoracic Surgeons (ESTS)

Timothy J.P. Batchelor[a,*], Neil J. Rasburn[b], Etienne Abdelnour-Berchtold[c], Alessandro Brunelli[d], Robert J. Cerfolio[e], Michel Gonzalez[c], Olle Ljungqvist[f], René H. Petersen[g], Wanda M. Popescu[h], Peter D. Slinger[i] and Babu Naidu[j]

**Table 1: Continued**

| Recommendations | Evidence level | Recommendation grade |
|---|---|---|
| Intercostal muscle- and nerve-sparing techniques are recommended | Moderate | Strong |
| Reapproximation of the ribs during thoracotomy closure should spare the inferior intercostal nerve | Moderate | Strong |
| Surgical technique: minimally invasive surgery | | |
| A VATS approach for lung resection is recommended for early-stage lung cancer | High | Strong |
| Postoperative phase | | |
| Chest drain management | | |
| The routine application of external suction should be avoided | Low | Strong |
| Digital drainage systems reduce variability in decision-making and should be used | Low | Strong |
| Chest tubes should be removed even if the daily serous effusion is of high volume (up to 450 ml/24 h) | Moderate | Strong |
| A single tube should be used instead of 2 after anatomical lung resection | Moderate | Strong |
| Urinary drainage | | |
| In patients with normal preoperative renal function, a transurethral catheter should not be routinely placed for the sole purpose of monitoring urine output | Moderate | Strong |
| It is reasonable to place a transurethral catheter in patients with thoracic epidural anaesthesia | Low | Strong |
| Early mobilization and adjuncts to physiotherapy | | |
| Patients should be mobilized within 24 h of surgery | Low | Strong |
| Prophylactic minitracheostomy use may be considered in certain high-risk patients | Low | Weak |

ERAS: Enhanced Recovery After Surgery; ESTS: European Society of Thoracic Surgeons; LMWH: low-molecular-weight heparin; NSAID: non-steroidal anti-inflammatory drugs; PONV: postoperative nausea and vomiting; VATS: video-assisted thoracoscopic surgery; VTE: venous thromboembolism.

REVIEW

CURRENT OPINION

# A surgical perspective of ERAS guidelines in thoracic surgery

*Tim J.P. Batchelor*[a] *and Olle Ljungqvist*[b]

## KEY POINTS

- VATS lobectomy is associated with reduced pain and fewer complications compared to open surgery.
- Conservative chest tube management protocols do not benefit the patient and result in a longer length of stay.
- Early mobilization reduces complications and length of stay after lung resection.
- Increasing compliance with an ERAS pathway leads to fewer complications and a shorter length of stay.

# What is Thoracic ERP?

| Preoperative | Perioperative | Postoperative |
| --- | --- | --- |
| • Patient education<br>• Avoidance of prolonged fasting<br>• Smoking cessation<br>• Prehabilitation | • Warming of the patient<br>• Adequate pain control<br>• Balanced fluid regimen<br>• Minimally invasive approach | • Early mobilization<br>• Early feeding<br>• Early removal of UC and IV lines<br>• Early chest tube removal criteria |

# Checklist Enhanced Recovery Program (ERP) Longresecties *

**Raadpleging**
- ☐ PROM patient reported outcome meas.
- ☐ Preop (télé) raadpleging
- ☐ Inschatting hoog risico longchirurgie
  - ☐ Pneumonectomie / Bilobectomie
  - ☐ ppoFEV1<40%
  - ☐ ppoDLCO<40%
  - ☐ VO2max <15 ml/kg/min
  - ☐ MRC Dyspnoe score >3
- ☐ Brochure, consult, voorschrift Kiné bij hoog risico
- ☐ Valrisico in KWS
- ☐ preop ANE raadpleging
- ☐ Sociaal assistente contacteren (46742) indien:
  - ☐ alleenstaand /postop hulp nodig thuis
  - ☐ hoog risico
  - ☐ ontslag naar huis niet realistisch
  - ☐ hulp voor familie
- ☐ Rookstop aangeboden /niet relevant
- ☐ Voedingssuplement bij ondervoeding
- ☐ Advies anti-coagulantia
- ☐ Categorie 1/2/3 in OK bon 'vraag aan ANE'(*):
  - 1 Thoracotomie of rib resectie
  - 2 MultiPort VATS/RATS
  - 3 Uniportal VATS

**Preoperatief**
- ☐ Lichte voeding tot 6h preop
- ☐ Clear Fluids tot 2h preop
- ☐ **Orale carbohydrate** drank @5h of @8h
- ☐ Vermijden sederende premedicatie
- ☐ Gewicht meten

**Peroperatief**

Zo PCEA: niveau T5-6, T6-7, geen Sufenta toevoegen
Long protectieve beademing, short acting volatiles, fluid restriction (cfr protocol ANE)
Nausea preventie, geen maagsonde, onderkoeling preventie
Arteriële lijn niet standaard, cfr supervisor ANE
DVC enkel bij moeilijke acces of ernstige cardio resp morbiditeit
Blaassonde bij PCEA, anders enkel op indicatie **
Maximale perop luchtlek preventie en behandeling

| Categorie 1<br>Thoracotomie of Rib Resectie | Categorie 2<br>MultiPort VATS/RATS | Categorie 3<br>Uniportal VATS |
|---|---|---|
| EMV "Thoractomie 5d PCEA" | EMV "VATS lobe 3d PCEA" | EMV "VATS lobe geen PCEA" |
| Blaassonde | Blaassonde bij PCEA of ** | Blaassonde bij ** |
| PCEA tot D5 | PCEA (of studiekatheter) tot D3 of tot verwijderen TD | Geen PCEA: chirurgisch/ANE block |
| Perfusalgan IV ☛ Dafalgan po<br>Taradyl / Ibuprofen IV ☛ po<br>zo nodig: morfine sc ☛ MS direct | | |
| Durogesic 12µgr 20h 's avonds voor verwijderen PCEA | Durogesic 12µgr 20h 's avonds voor verwijderen PCEA of bij pijncatheter reeds op PAZA | Durogesic 12µgr zo MS direct 4x/d |
| Failed epidurale?<br>Herprikken 1x, niet beter ☛ PCIA | Failed epidurale?<br>Niet herprikken, evt. PCIA | |
| PAZA : 1 nacht | PAZA: cfr ontslag beleid | PAZA: cfr ontslag beleid |
| CH 28 thoraxdrain<br>Klassieke thoraxbak, geen suctie | Overweeg CH 20-24 thoraxdrain<br>Digitale drainage: 1TD -2cm H2O | Overweeg CH 20-24 thoraxdrain<br>Digitale drainage: 1TD -2cm H2O |

**Postoperatief**
Uit bed, zo mogelijk binnen het uur na extubatie.
cfr separaat Kiné protocol (in progress)
IV Fluid Restriction, herstart perorale vocht intake
TD verwijderen vanaf D1 zo geen luchtlek,
niet chyleus, niet bloederig tot **450cc/dag**

**PAZA ontslag beleid: 1 nacht op PAZA**
blijft standaard bij anatomische resecties
(pneumonectomie, lobectomie, segmentectomie)
**Uitzondering** bij wig of zo alle volgende geldt:
- o Categorie 2-3 (VATS), geen hoog risico
- o Overleg supervisie ANE - chirurg
- o Patiënt in PAZA voor 13h
- o transfer naar E653 mogelijk voor 18h
- o Wakker en adequaat, pijn onder controle
- o Heeft gestapt (naast bed) op de PAZA
- o Stabiele parameters
- o O2 neusbril voldoende

**E653:**
Blaassonde bij PCEA verwijderen D1 tenzij **
Gewicht dagelijks meten
Patiënten mogen zaal verlaten met PCEA
Rx op radiologie zo zelfstandig stappen op gang
Telemetrie tot 24h na transfer PAZA
Telemetrie min. 3d. bij pneumec / hoog risico
DVT prophylaxis
DVC uit op advies

**Ontslag**: Tele Coaching (in progress)

**Medical Research Council (MRC) Dyspnoe schaal**
0 Ik heb geen last van kortademigheid
1 Ik word alleen kortademig bij zware inspanning
2 Ik word alleen kortademig als ik me moet haasten op vlak terrein of tegen een lichte helling oploop
3 Door mijn kortademigheid loop ik op vlak terrein langzamer dan andere mensen van mijn leeftijd, of moet ik stoppen om op adem te komen als ik mijn eigen tempo loop
4 Na ongeveer 100 meter lopen op vlak terrein moet ik na een paar minuten stoppen om op adem te komen
5 Ik ben te kortademig om het huis uit te gaan, of ik ben kortademig tijdens het aan- of uitkleden

* Buiten Categorie: Non-intubated Surgery: Separaat EMV met 1 dag PCEA, verder vergelijkbaar met Categorie 3
* Buiten Categorie: Extrapleurale Pneumonectomie: cfr protocolboek THO en separaat EMV
** Extra indicatie blaassonde naast PCEA: nierfalen, corfalen, pneumonectomie, complexe of langdurige (>3h) ingrepen, te verwachten belangrijke volumeshifts

Versie 1.1 27/08/2019 H. Decaluwé (46866)

**Raadpleging**

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- ☐ Valrisico in KWS
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  - ☐ alleenstaand /postop hulp nodig thuis
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- ☐ Rookstop aangeboden /niet relevant
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- ☐ Advies anti-coagulantia
- ☐ Categorie 1/2/3 in OK bon 'vraag aan ANE'(*):
  - 1 Thoracotomie of rib resectie
  - 2 MultiPort VATS/RATS
  - 3 Uniportal VATS

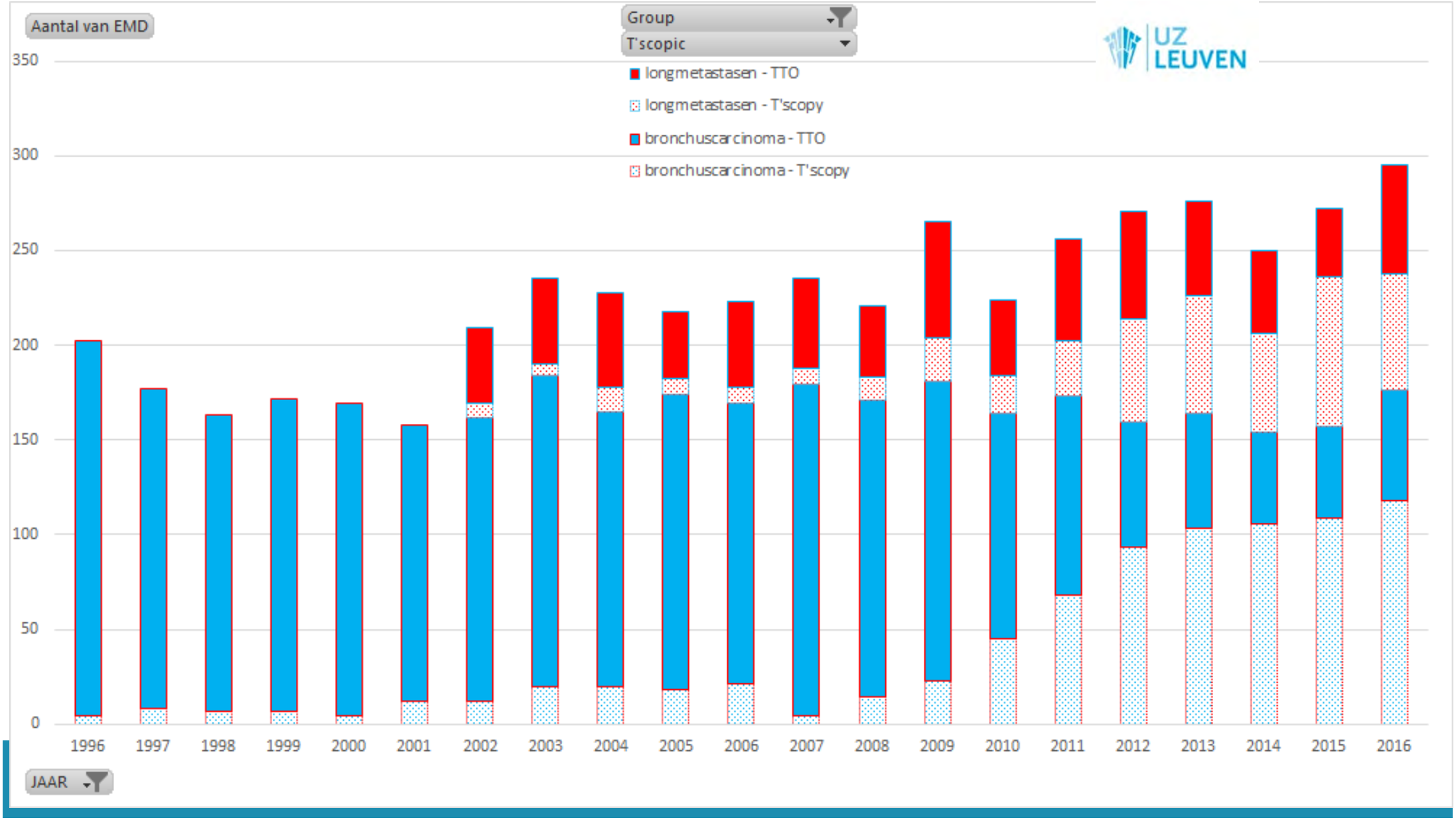
**Preoperatief**

- ☐ Lichte voeding tot 6h preop
- ☐ Clear Fluids tot 2h preop
- ☐ **Orale carbohydrate** drank @5h of @8h
- ☐ Vermijden sederende premedicatie
- ☐ Gewicht meten

**Peroperatief**

Zo PCEA: niveau T5-6, T6-7, geen Sufenta toevoegen
Long protectieve beademing, short acting volatiles, fluid restriction (cfr protocol ANE)
Nausea preventie, geen maagsonde, onderkoeling preventie
Arteriële lijn niet standaard, cfr supervisor ANE
DVC enkel bij moeilijke acces of ernstige cardio resp morbiditeit
Blaassonde bij PCEA, anders enkel op indicatie **
Maximale perop luchtlek preventie en behandeling

| Categorie 1 | Categorie 2 | Categorie 3 |
| --- | --- | --- |
| **Thoracotomie of Rib Resectie** | **MultiPort VATS/RATS** | **Uniportal VATS** |


Aantal van EMD
Group
T'scopic
longmetastasen - TTO
longmetastasen - T'scopy
bronchuscarcinoma - TTO
bronchuscarcinoma - T'scopy
UZ LEUVEN
350
300
250
200
150
100
50
0
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
JAAR

| Categorie 1<br>Thoracotomie of Rib Resectie | Categorie 2<br>MultiPort VATS/RATS | Categorie 3<br>Uniportal VATS |
|---|---|---|
| EMV "Thoractomie 5d PCEA" | EMV "VATS lobe 3d PCEA" | EMV "VATS lobe geen PCEA" |
| Blaassonde | Blaassonde bij PCEA of ** | Blaassonde bij ** |
| PCEA tot D5 | PCEA (of studiekatheter) tot D3<br>of tot verwijderen TD | Geen PCEA: chirurgisch/ANE block |
| Perfusalgan IV ☛ Dafalgan po<br>Taradyl / Ibuprofen IV ☛ po<br>zo nodig: morfine sc ☛ MS direct | | |
| Durogesic 12µgr 20h 's avonds<br>voor verwijderen PCEA | Durogesic 12µgr 20h 's avonds<br>voor verwijderen PCEA<br>of bij pijncatheter reeds op PAZA | Durogesic 12µgr zo MS direct 4x/d |
| Failed epidurale?<br>Herprikken 1x, niet beter ☛ PCIA | Failed epidurale?<br>Niet herprikken, evt. PCIA | |
| PAZA : 1 nacht | PAZA: cfr ontslag beleid | PAZA: cfr ontslag beleid |
| CH 28 thoraxdrain<br>Klassieke thoraxbak, geen suctie | Overweeg CH 20-24 thoraxdrain<br>Digitale drainage: 1TD -2cm H2O | Overweeg CH 20-24 thoraxdrain<br>Digitale drainage: 1TD -2cm H2O |

**Postoperatief**
Uit bed, zo mogelijk binnen het uur na extubatie.
cfr separaat Kiné protocol (in progress)
IV Fluid Restriction, herstart perorale vocht intake
TD verwijderen vanaf D1 zo geen luchtlek,
niet chyleus, niet bloederig tot **450cc/dag**

**PAZA ontslag beleid: 1 nacht op PAZA**
blijft standaard bij anatomische resecties
(pneumonectomie, lobectomie, segmentectomie)
**Uitzondering** bij wig of zo alle volgende geldt:
- Categorie 2-3 (VATS), geen hoog risico
- Overleg supervisie ANE - chirurg
- Patiënt in PAZA voor 13h
- transfer naar E653 mogelijk voor 18h
- Wakker en adequaat, pijn onder controle
- Heeft gestapt (naast bed) op de PAZA
- Stabiele parameters
- O2 neusbril voldoende

**E653:**
Blaassonde bij PCEA verwijderen D1 tenzij **
Gewicht dagelijks meten
Patiënten mogen zaal verlaten met PCEA
Rx op radiologie zo zelfstandig stappen op gang
Telemetrie tot 24h na transfer PAZA
Telemetrie min. 3d. bij pneumec / hoog risico
DVT prophylaxis
DVC uit op advies


- Starving patients
- Bedrest
- Tranquilizers
- Central IV lines
- Suction on T Tube
- U Catheters
- PCEA ?
- Opioids

# July 2010 - July 2016

290 lobectomies

## Ambulation Results

- 197 patients walked within 1 hour (68%)
- 239 patients walked>250 feet (82%)
- 175 patients walked >250 feet within 1 hour (60%)
- 5 patients just couldn't walk in PACU (1.7%)
- No adverse events

## Inova Outcomes

- Readmission - 4.8%
- Atrial Arrhythmia - 4.1%
- Pneumonia - 1%
- Airleak >5days - 6.6%
- DVT - 0.7%
- ARF - 0.3%
- PE - 0.3%
- Stroke, MI, Death - 0%
- Median/Mean LOS - 1/1.6 days

# Patient Education!

- Brisk walks prior to surgery
- Walking to the operating table
- Taking stairs = Going Home

# Checklist Enhanced Recovery Program (ERP) Longresecties *

**Raadpleging**

- ☐ PROM patient reported outcome meas.
- ☐ Preop (télé) raadpleging
- ☐ Inschatting hoog risico longchirurgie
  - ☐ Pneumonectomie / Bilobectomie
  - ☐ ppoFEV1<40%
  - ☐ ppoDLCO<40%
  - ☐ VO2max <15 ml/kg/min
  - ☐ MRC Dyspnoe score >3
- ☐ Brochure, consult, voorschrift Kiné bij hoog risico
- ☐ Valrisico in KWS
- ☐ preop ANE raadpleging
- ☐ Sociaal assistente contacteren (46742) indien:
  - ☐ alleenstaand /postop hulp nodig thuis
  - ☐ hoog risico
  - ☐ ontslag naar huis niet realistisch
  - ☐ hulp voor familie
- ☐ Rookstop aangeboden /niet relevant
- ☐ Voedingssuplement bij ondervoeding
- ☐ Advies anti-coagulantia
- ☐ Categorie 1/2/3 in OK bon 'vraag aan ANE'(*):
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DVT prophylaxis
DVC uit op advies

**Ontslag**: Tele Coaching (in progress)

**Medical Research Council (MRC) Dyspnoe schaal**

0 Ik heb geen last van kortademigheid
1 Ik word alleen kortademig bij zware inspanning
2 Ik word alleen kortademig als ik me moet haasten op vlak terrein of tegen een lichte helling oploop
3 Door mijn kortademigheid loop ik op vlak terrein langzamer dan andere mensen van mijn leeftijd, of moet ik stoppen om op adem te komen als ik mijn eigen tempo loop
4 Na ongeveer 100 meter lopen op vlak terrein moet ik na een paar minuten stoppen om op adem te komen
5 Ik ben te kortademig om het huis uit te gaan, of ik ben kortademig tijdens het aan- of uitkleden

* Buiten Categorie: Non-intubated Surgery: Separaat EMV met 1 dag PCEA, verder vergelijkbaar met Categorie 3
* Buiten Categorie: Extrapleurale Pneumonectomie: cfr protocolboek THO en separaat EMV
** Extra indicatie blaassonde naast PCEA: nierfalen, corfalen, pneumonectomie, complexe of langdurige (>3h) ingrepen, te verwachten belangrijke volumeshifts

UZ LEUVEN

Versie 1.1 27/08/2019 H. Decaluwé (46866)