Thoracoscopic anatomic left $S^{1+2}_{ab}$ subsegmentectomy involving the left upper pulmonary vein of the central vein type

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Dividing the intersegmental parenchyma along the pulmonary vein with an anterior approach during thoracoscopic left $S^{1+2}$ segmentectomy of the central vein type is assumed to be difficult. Herein we describe a left $S^{1+2}_{ab}$ subsegmentectomy performed with other methods to overcome this difficulty.

CASE PRESENTATION

A 75-year-old man with suspected lung cancer was admitted to the hospital. A 1.0-cm solid nodule was demonstrated in the left $S^{1+2}_b$ subsegment. The left upper pulmonary vein pattern was a central vein type (Figure 1). Based on preoperative 3-dimensional computed tomography (3D-CT) imaging simulation using vascular reconstruction and a lung perspective, we planned a thoracoscopic left $S^{1+2}_{ab}$ subsegmentectomy by dividing the intersegmental parenchyma between $S^{1+2}$ and $S^3$ along the line connecting the root of $A^3$ and the concave portion of the apical pleura (Figure 2). Using 4 access ports, the subsegmental arteries ($A^{1+2}_{ab}$) were divided, and subsegmental bronchi ($B^{1+2}_{ab}$) were dissected. Hilar lymph node metastases were not noted on frozen sections. The bronchi were closed with a slip knot after both lungs were inflated, then divided. Due to the inflation–deflation line created with the slip-knot method, $S^{1+2}_a$ was slightly brighter than $S^3_c$, making the intersegmental line visible. The parenchyma was then divided using a stapler along the inflation–deflation line, as well as the line connecting the root of $A^3$ and the concave portion of the apical pleura. After the parenchymal division, intrasegmental veins ($V^{1+2}_{ab}$) were identified and divided, and the parenchyma between $S^{1+2}_b$ and $S^{1+2}_c$ was divided while preserving the intersubsegmental vein ($V^{1+2}_{bc}$) (Video 1). The long surgical time (378 minutes) and blood loss (137 mL) were attributed to the need for extensive adhesiolysis.

The tumor was diagnosed as a mucinous adenocarcinoma (T1a N0 M0-1 A1) based on the pathologic evaluation. There were no complications or recurrences at 7-month postoperative follow-up. The patient provided informed consent for study data publication.
Traditionally, the left upper pulmonary vein is considered to have 3 main variations (apical, apicocentral, and central vein types). Although several branch types have been recently reported, the central vein type is still very rare (2.9% and 2.8%). The pulmonary parenchyma is usually easily divided between S1+2 and S3 along the intersegmental vein with the anterior approach in the apical or apicocentral vein types because these veins run through the anterior site. In the central vein type, pulmonary veins run posterior to A3. This anatomical difference makes it difficult to divide the demarcation line.

Before and during thoracoscopic segmentectomies, we usually simulate the procedures using 3D-CT images; it was not possible to divide the pulmonary parenchyma along the intersegmental vein with the anterior approach in the central vein type. Referring to the lung perspective of this patient, we noticed an avascular area within the parenchyma at the line connecting the root of A3 with the concave portion of the apical visceral pleura. We reasoned that dividing this area would enable us to perform the intersegmental division in the segmentectomy. Furthermore, the interlobar fissure was incomplete between S1+2 and S6. Therefore, we decided that a thoracoscopic left S1+2ab subsegmentectomy was the appropriate procedure. Ultimately, this procedure was completed using the anterior approach by following this simulation.

Segmentectomies require planning based on a precise anatomic understanding. The detailed steps according to each pulmonary vein type in the right upper lobe have...
been previously reported.\textsuperscript{5} The procedural steps might be
categorized based on the corresponding patterns in an
\( S^1 + 2 \) segmentectomy. In the apical and apicocentral veins,
the parenchymal division between \( S^1 + 2 \) and \( S^3 \) along the
intersegmental vein (\( V^1 + 2_a \)) might be preferred in the first
step. In contrast, in the central vein type it is recommended
that the pulmonary arteries are divided as the first step, and
the segmental parenchyma between \( S^1 + 2 \) and \( S^3 \) is divided
as the second step. In the demarcation line of the interseg-
ment between \( S^1 + 2 \) and \( S^3 \), the line connecting the root of
\( A^3 \) and the concave portion of the pleura can be helpful.
Although indocyanine green is widely used, this option
was not available at our institution. Furthermore, even if in-
docyanine green had been used, the intersegmental line may
not have been visible due to the severe adhesion and thick
visceral pleura of this patient. Our proposed procedure-
related steps are still experimental because this is the first
case performed with this approach. It is therefore necessary
to accumulate cases of thoracoscopic \( S^1 + 2 \) segmentectomy
with the central vein type.

CONCLUSIONS
A 3D-CT imaging simulation using both vascular recon-
struction and a lung perspective is useful when performing a
thoracoscopic anatomic \( S^1 + 2ab \) subsegmentectomy of the
central vein type.

Webcast
You can watch a Webcast of this AATS meeting presenta-
tion by going to: https://www.aats.org/resources/1750.

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Discussion
Presenter: Dr Hirohisa Kato
Dr Bernard Park (New York, NY). [applause] This will
be discussed by Dr Seder from Rush University.

Dr Christopher Seder (Chicago, Ill).
Congratulations, Dr Kato, on an excel-
 lent video demonstrating this apical
posterior segmentectomy in a patient
with a central vein type anatomy. The
video nicely demonstrates you taking the artery, then
bronchus, then vein. I suspect some surgeons may have
skipped the vein and just taken the artery and bronchus in
a case like this. Obviously, for this case, the preoperative
3-dimensional computed tomography (3D-CT) reconstruc-
tion really helped you in your planning. Do you use 3D
reconstruction for all of your segmentectomies?

Dr Hirohisa Kato (Yamagata, Japan).
All cases?

Dr Seder. Yeah, you use–?
Dr Kato. Yes. Yes.
Dr Seder. Oh. So you use 3D reconstruction for all
segmentectomies?
Dr Kato. Yes. When we perform segmentectomy, we always
plan a segmentectomy using a 3D-CT simulation,
about 30 minutes. Yeah.

Dr Seder. I see. Have you done this operation before in
other patients with central vein type? Or is this the only 1
that you’ve seen like this?
Dr Kato. I have 3 cases of central vein type, is [inaudible] 2 segmentectomy. Actually, this case is first case I perform this segmentectomy. Other cases, my colleague performed segmentectomy.

Dr Seder. Have you found that concave portion of the visceral pleura, that avascular line between the concave portion and the root of A3, has been there in all 3 cases in order to create that intersegmental plane?

Dr Kato. The other 2 cases were not analyzed because this segmentectomy was performed in a previous institute. Recently, I moved another hospital, so in the future, I analyzed this anatomy.

Dr Seder. Thank you very much. It’s a great presentation.

Dr Park. [applause] I think there’s 1 more question. Yeah?

Unidentified Speaker 2. Thanks so much. Do you use routinely any form of, let’s say, indocyanine green (ICG) after you’ve divided the vasculature, subsegmental setting with this segment, a subsegmental setting? And do you find it accurate?

Dr Kato. In my institution, I have no ICG system, so I could not use ICG. But even if we use an ICG system, I don’t know whether or not the patient’s intersegmental line could be clearly visualized because this patient had a severe adhesion and the visceral pleura was thick.

Unidentified Speaker 2. Thank you.

Dr Park. All right, great. I think that ends our section. That was a wonderful presentation. And safe travels to everyone going home.