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ORIGINAL ARTICLE / ÖZGÜN MAKALE

Postoperative pulmonary complications in awake video-assisted thoracoscopic surgery: Our 10-year experience

Uyanık video yardımlı torakoskopik cerrahide ameliyat sonrası pulmoner komplikasyonlar: 10 yıllık deneyimimiz

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ABSTRACT

Background: The aim of this study was to evaluate the effect of awake video-assisted thoracoscopic surgery on postoperative pulmonary complications among patients with different risk scores using the Assess Respiratory Risk in Surgical Patients in Catalonia (ARISCAT).

Methods: Between January 2011 and August 2021, a total of 246 patients (158 males, 88 females; mean age: 59.1±13.6 years; range, 25 to 84 years) who underwent awake video-assisted thoracoscopic surgery were retrospectively analyzed. According to the ARISCAT scores, the patients with low and intermediate scores were included in Group L (n=173), while those with high scores (n=73) were included in Group H. Sedation protocol consisted of the combination of midazolam and fentanyl with propofol infusion, if necessary. Oxygen was delivered via face mask or nasal canula (2 to 5 L/min) maintaining an oxygen saturation of >95%, and analgesia was achieved with intercostal nerve block. Demographics, operative, and postoperative data of the patients, and pulmonary complications were evaluated.

Results: Demographics, operative, and postoperative data were similar between the groups. Postoperative pulmonary complications were observed in 20 (27%) patients in Group H and 29 (17%) patients in Group L without statistically significant difference (p=0.056). Surgical approaches consisted of pleural procedures (n=194) and pulmonary resection (n=52). The incidence of pulmonary complications was significantly higher in the pulmonary resection compared to non-pulmonary procedures (p=0.027).

Conclusion: Awake video-assisted thoracoscopic surgery seems to be beneficial in reducing the incidence of postoperative pulmonary complications in high-risk patients as assessed with the ARISCAT.

Keywords: ARISCAT, awake, postoperative pulmonary complications, video-assisted thoracoscopic surgery.

ÖZ

Amaç: Bu çalışmada Assess Respiratory Risk in Surgical Patients in Catalonia (ARISCAT) kullanılarak farklı risk skorlarına sahip hastalar arasında uyanık video yardımlı torakoskopik cerrahinin ameliyat sonrası pulmoner komplikasyonlar üzerindeki etkisi değerlendirildi.

Çalışma planı: Ocak 2011-Ağustos 2021 tarihleri arasında uyanık video yardımlı torakoskopik cerrahi uygulanan toplam 246 hasta (158 erkek, 88 kadın; ort. yaş: 59.1±13.6 yıl; dağılım, 25-84 yıl) retrospektif olarak incelendi. ARISCAT skorlarına göre düşük ve orta skora sahip hastalar Grup L'ye (n=173), yüksek skora sahip olanlar ise Grup H'ye (n=73) dahil edildi. Sedasyon protokolü midazolam ile fentanil kombinasyonu ve gerekirse propofol infüzyonundan oluşuyordu. Oksijen desteği, oksijen satürasyonu >%95 olacak şekilde yüz maskesi veya nazal kanül (2-5 L/dk.) ile verildi ve analjezi interkostal sinir bloku ile sağlandı. Hastaların demografik, ameliyat ve ameliyat sonrası verileri ve pulmoner komplikasyonları değerlendirildi.

Bulgular: Gruplar arasında demografik, ameliyat ve ameliyat sonrası veriler benzerdi. Ameliyat sonrası pulmoner komplikasyonlar istatistiksel olarak anlamlı bir fark olmaksızın Grup H'de 20 (%27) hastada ve Grup L'de 29 (%17) hastada gözlendi (p=0.056). Cerrahi yaklaşımlar plevral işlemler (n=194) ve pulmoner rezeksiyonlardan (n=52) oluşuyordu. Pulmoner komplikasyonların insidansı, pulmoner dışı işlemlere kıyasla, pulmoner rezeksiyonlarda anlamlı düzeyde daha yüksekti (p=0.027).

Sonuç: Uyanık video yardımlı torakoskopik cerrahi, ARISCAT ile değerlendirildiği üzere yüksek riskli hastalarda ameliyat sonrası pulmoner komplikasyon insidansını azaltmada faydalı görülmektedir.

Anahtar sözcükler: ARISCAT, uyanık, ameliyat sonrası pulmoner komplikasyonlar, video yardımlı torakoskopik cerrahi.

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Video-assisted thoracoscopic surgery (VATS) in an awake patient has become increasingly popular with certain advantages of reduced complications and shortened length of hospital stay (LOS) achieved by rapid recovery. Surgical spectrum for thoracoscopic procedures has been extended from pleural procedures to lung resection. Preservation of spontaneous respiration and maintained airway reflexes seems to be advantageous for high-risk patients. Meta-analyses reported decreased pulmonary complications, shortened hospital stay, and even decreased morbidity with awake VATS (AVATS).[1-3] Meanwhile, large variety of procedures is associated with different approaches for airway control and analgesia.[4-6]

From the first meta-analysis, AVATS appeared to be advantageous in terms of postoperative complications and short-term outcomes.[2] Regarding systemic complications, pulmonary outcomes deserve special interest for thoracic surgery. At this point, it seems to be rational to distinguish high-risk patients from low-risk ones with established risk scores. The Assess Respiratory Risk in Surgical Patients in Catalonia (ARISCAT) score, which is a risk assessment tool for developing postoperative pulmonary complications (PPCs), consists of preoperative patient characteristics and operative data (age, comorbidities/respiratory infection, oxygen saturation (SpO_2), anemia, type/site of surgery, duration of surgery, and emergency).[7] Low risk means an incidence of PPC about 1%, whereas intermediate and high-risk groups are associated with an incidence of 13% and 42%, respectively.[7]

In the present study, we aimed to compare the incidence of PPC in two risk groups screened with ARISCAT for patients undergoing AVATS over a 10-year period.

PATIENTS AND METHODS

This single-center, retrospective study was conducted at Istanbul University Istanbul Faculty of Medicine, Deparment of Anesthesiology and Reanimation and Thoracic Surgery between January 2011 and August 2021. A total of 268 patients who underwent elective AVATS during the study period were screened. Patients who were converted to general anesthesia (n=4) and those with missing data (n=18) were excluded from the study. Finally, a total of 246 patients (158 males, 88 females; mean age: 59.1±13.6 years; range, 25 to 84 years) who met the inclusion criteria were recruited. The ARISCAT score was calculated for each patient from medical records.[7] The patients were divided in two groups according to their ARISCAT scores. Those who had low and intermediate ARISCAT score were included in Group L (n=173) and high score patients in Group H (n=73).

Demographic, operative, and postoperative data including the duration of post-anesthesia care unit, chest tube removal time, and LOS were collected from medical records. Pulmonary complications were screened according to the literature.[7]

Surgical approach

After thoracoscopic port was placed under local infiltration with a mixture of lidocaine and bupivacaine, the surgical team performed intercostal nerve block (ICNB) at T4-T7 levels by direct vision of intercostal nerve via thoracoscope. Our surgical approach involves usually biportal VATS, with 10-mm ports, one for camera and the other for the working port for pleural diseases. In lung resections, we use the utility port and a 10-mm camera port. Additionally, we expand the working port and install a wound retractor for the removal of the wedge resection specimen. At the end of the operation, we thoroughly monitor for air leakage and hemorrhage, and insert chest tube into the thoracic cavity.

Anesthesia management

All patients were monitored according to the American Society of Anesthesia (ASA) with electrocardiography, non-invasive blood pressure and peripheral oxygen saturation. Sedation protocol comprised combination of midazolam and fentanyl with propofol infusion, if necessary. The patients maintained spontaneous ventilation and cooperation during procedure with a Ramsay sedation score of <3.[8] Oxygen was delivered via face mask or nasal canula (2 to 5 L/min) maintaining SpO_2 >95% throughout the procedure.

Statistical analysis

Statistical analysis was performed using the IBM SPSS for Windows version 22.0 software (IBM Corp., Armonk, NY, USA). Descriptive data were expressed in mean ± standard deviation (SD), median (min-max) or number and frequency, where applicable. The Kolmogorov-Smirnov test was performed to assess the normality of data distribution. Normally distributed quantitative data were compared using the Student t-test. Non-normally distributed data were compared using the Mann-Whitney U test. The chi-square test was used to analyze categorical data. A *p* value of <0.05 was considered statistically significant.

RESULTS

Demographic, operative and follow-up data of all patients are summarized in Table 1.

Table 1. Demographic, operative and follow up data of overall patients

	Overall population (n=246)		
	n	%	Mean±SD
Age (year)			59.1±13.6
Sex			
Female	88	36	
Male	158	64	
ASA classification			
I	33	13.5	
II	178	72.5	
III	35	14	
Surgical procedure			
Pleural drainage and biopsy	142	58	
Empyema delocculation	31	13	
Pleural biopsy	21	8	
Wedge resection	52	21	
Side of surgery			
Right	147	60	
Left	99	40	
Number of port incisions			
Uniportal	88	36	
Biportal	158	64	
Duration of surgery (min)			29.47±7.41
Duration of anesthesia (min)			35.63±7.73
Duration of PACU (min)			33.63±12.56
Chest tube removal time (days)			1.94±1.15
LOS (days)			3.07±1.51
Pulmonary complications			
Yes	49	20	
No	197	80	

SD: Standard deviation; ASA: American Society of Anesthesia; PACU: Post-anesthesia care unit; LOS: Length of hospital stay.

The mean ARISCAT score was 39.88±9.94 for entire study cohort. Overall distribution of the patients was as follows: 25 (10.2%) in low risk, 148 (60.2%) in moderate risk, and 73 (29.6%) in high risk. According to prespecified risk assessment, 73 patients were enrolled in Group H and 173 in Group L.

The demographics and operative data were compared between Group H and Group L and found to be similar, except for the ARISCAT score (Table 2). In our study population, surgery-related risk factors of ARISCAT (intrathoracic incision, duration of surgery, and emergency surgery) were similar. The related risk factors of the patients were significantly different between the groups ($p<0.001$) (Table 3).

Postoperative data did not show any statistically significant difference between the groups. Duration of post-anesthesia care unit were 34.65±10.55 min in Group H and 33.2±13.32 min in Group L ($p=0.41$). The median time to chest tube removal was 2 (range, 1 to 8) days in Group H and 2 (range, 1 to 6) days in Group L ($p=0.08$). The median postoperative LOS was 3 (range, 2 to 15) days in Group H and 3 (range, 2 to 11) days in Group L ($p=0.15$). Postoperative pulmonary complications were observed in 20 (27%) patients in Group H and 29 (17%) patients in Group L without a statistically significant difference ($p=0.056$). Surgical approaches consisted of pleural procedures (n=194) and pulmonary resection (n=52); and PPC incidence was significantly higher in the pulmonary resection

Table 2. Demographics and operative data between the groups

	Group H (n=73)					Group L (n=173)					
	n	%	Mean±SD	Median	Min-Max	n	%	Mean±SD	Median	Min-Max	*p*
Age (year)			59.8±14.2		25-84			58.8±13.4		36-84	0.605
Sex											0.974
Female	26					62					
Male	47					111					
ASA classification											
I	8	11				25	15				0.462
II	51	70				127	73				0.569
III	14	19				21	12				0.148
Surgical procedure											0.883
Pulmonary	15					37					
Non-pulmonary	58					136					
Wedge resection	15	20				37	37				
Pleural drainage and biopsy	40	55				102	59				
Empyema delocculation	11	15				20	11				
Pleural biopsy	7	10				14	8				
Side of surgery											0.860
Right	43					104					
Left	30					69					
Number of ports											0.401
Uniportal	29					59					
Biportal	44					114					
Duration of surgery (min)			29.45±8.27					29.47±7.05			0.979
Duration of anesthesia (min)			36.5±9.11					35.26±7.07			0.249
Duration of PACU (min)			34.65±10.55					33.2±13.32			0.410
Chest tube removal time (days)				2	1-8				2	1-6	0.089
LOS (days)				3	2-15				3	2-11	0.156
Pulmonary complications											0.056
Yes	20					29					
No	53					144					
ARISCAT score			51.15±4.15					35.12±7.55			<0.001

SD: Standard deviation; ASA: American Society of Anesthesiologists; PACU: Post-anesthesia care unit; LOS: Length of hospital stay; ARISCAT: Assess Respiratory Risk in Surgical Patients in Catalonia.

Table 3. ARISCAT components according to groups

	Group H (n=73)		Group L (n=173)		
	n	%	n	%	*p*
Preoperative SpO_2 91-95%	54	74	46	26	<0.001
Respiratory infection in the last month	42	57	28	16	<0.001
Preoperative anemia (≤10 g/dL)	41	56	45	26	<0.001

ARISCAT: Assess Respiratory Risk in Surgical Patients in Catalonia.

compared to non-pulmonary procedures (16 [30%] and 33 [17%], respectively; p=0.027).

DISCUSSION

In the present study, we observed a trend of decreased PPC incidence in lower ARISCAT group compared to high-risk group which did not show statistical significance in patients undergoing AVATS. The overall rate was about 20%, whereas it was 27% and 17% in high and low risk groups, respectively. To the best of our knowledge, this is the first study to investigate PPC with ARISCAT score as a primary outcome in awake thoracoscopic surgery.

Pulmonary complications affect patients' outcome seriously and prediction constitutes major challenge, particularly for high-risk surgery such as thoracic procedures. Preoperative risk assessment is mostly common performed by the ASA. Awake VATS patients were mostly evaluated with ASA score in previous studies; however, it does not appear to be suitable for PPC prediction.[9,10] We deliberately choose ARISCAT to precisely detect high-risk patients for a minimally invasive approach. This score is focused on both patients' risk status and operative risk factors.[7] In our literature research, there is only one study investigating patients' risk with a variety of scores including ARISCAT.[11]

Minimally invasive surgery is commonly recommended for both high-risk patients or surgery to improve postoperative outcomes, and anesthetic management should be tailored considering this issue. Awake surgery offers advantage of spontaneous respiration with preserved airway reflexes and seems to be beneficial for pulmonary complications.[6,12] Abundance of comparative studies for AVATS is usually focused on feasibility, intraoperative complications, costs, or LOS.[13-18] However, there are few studies reporting pulmonary complications for AVATS; we highlighted six studies of AVATS with lung or pleural surgery (excluding mediastinal procedures or sympathectomy), comprising significant number of subjects, and investigating clearly pulmonary complications in Table 4.[9-11,19-21] Five of these studies consisted of pulmonary resection, whereas one investigated pleural surgery. The first one which is a randomized-controlled study for lung surgery, reported reduced incidence of PPC for AVATS compared to general anesthesia.[19] The remaining three studies did not show any significant superiority for AVATS in PPC and incidence was quite low (ranging from 2 to 8%) for thoracic surgery.[9,10,20] The large trial comprising only pleural surgery described 8% incidence of PPC.[21] Finally, in a full AVATS group, PPC incidence was 27% with minor and major surgery.[11] In our study, overall incidence of PPC was about 20% which appears to be significantly higher than previous papers; except for the last one. In our study, high ARISCAT scores come mainly from low SpO_2 prior to surgery, coexisting pulmonary infection and anemia. Indeed, surgical features were quite similar between the groups. Preoperative low SpO_2 (91 to 95%) was the most common factor about 75% of high-risk patients, followed by respiratory infection which was encountered about half of this group. We believe that ongoing infection affected our results and ensued a higher PPC incidence compared to previous studies.[9,10,19-21] It should be kept in mind that PPC rate was still found to be lower than ARISCAT predictions (27% in our study vs 42% in Canet et al.[7] probably due to advantages of AVATS. Starke et al.[11] confirmed lower PPC incidences in both minor and major surgery groups compared to predicted risk with ARISCAT. It can be explained by maintenance of spontaneous breathing without use of muscle relaxant and consistent use of regional analgesia.

Another significant risk factor for PPC is the nature of surgery. Rosboch et al.[6] underlined increased risk for lung surgery compared to pleural interventions. One remarkable study comparing major versus minor surgery in AVATS revealed significantly higher pulmonary complications for the first one.[11] Similarly, we observed a significantly increased trend for PPC in parenchymal procedures

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Table 4. Review of the literature studies

Author	Surgical procedure	Number of patients		ASA		Drugs for sedation	Type of analgesia	Airway management	PPC		LOS (days)	
			n		n					n		Mean or Mean±SD
Ke et al.[9]	Wedge resection	NIVATS VATS	81 79	I II III	5 59 17	Midazolam, Fentanyl, Propofol	TEA	THRIVE	Subcutaneous emphysema Pneumothorax Atelectasis Pneumonia Air leakage	4 2 0 0 1		2.8±1.4
Liu et al.[19]	Bullectomy Wedge resection Lobectomy	NIVATS VATS	167 180	-	-	Remifentanyl, Propofol	TEA, Vagal block	Nasopharyngeal airway, Laryngeal mask, Face mask	Atelectasis Pneumonia Bronchospasm Air leakage Respiratory failure	1 2 1 3 0	Bullectoy Wedge resection Lobectomy	5.8 8.2 9.5
Liu et al.[20]	Segmentectomy Lobectomy	NIVATS VATS	136 136	-	-	Remifentanyl, Propofol	TEA, Vagal block	Nasopharyngeal airway, Laryngeal mask, Face mask	Respiratory complications	11	Segmentectomy Lobectomy	6.0±1.2 7.4±2.0
Liu et al.[10]	Segmentectomy	NIVATS VATS	43 43	I II III IV	7 25 10 1	Remifentanyl, Propofol	ICNB, Vagal block	Nasopharyngeal airway, Laryngeal mask, Face mask	Pneumonia Hemothorax Wound infection Air leakage	0 0 0 1		3.1±0.7
Mineo et al.[21]	Pleurodesis	NIVATS VATS	231 231	-	-	Remifentanyl ± benzodiazepine	ICNB, Site injection (including subcutaneous layers, intercostal nerves, and parietal pleura)	Face mask	Subcutaneous emphysema Dystelectasis Pneumonia Air leakage Empyema	5 3 3 5 6		3.1±2.5
Starke et al.[11]	Pleurodesis Wedge resection Segmentectomy Lobectomy	Minor NIVATS Major NIVATS	48 40	I II III IV	5 26 53 4	Dexmedetomidine ± Sufentanil ± propofol	TEA, PVB, Vagal block	Laryngeal mask, Face mask	Pneumothorax Atelectasis Pneumonia Bronchospasm Air leakage Respiratory failure ARDS	0 6 3 0 10 4 1	Minor NIVATS Major NIVATS	6.40±4.51 10.10±6.50

ASA: American Society of Anesthesiologists; PPC: Postoperative pulmonary complication; LOS: Length of hospital stay; SD: Standard deviation; NIVATS: Non-intubated video-assisted thoracic surgery; VATS: Video assisted thoracoscopic surgery; TEA: Thoracic epidural analgesia; THRIVE: Transnasal humidified rapid-insufflation ventilatory exchange; ICNB: Intercostal nerve block; PVB: Paravertebral block; ARDS: Acute respiratory distress syndrome; Five studies[9,10,19,20,21] included NIVATS group compared to conventional thoracoscopic surgery; the last one[11] was composed of only NIVATS. Only NIVATS data of five studies are figured in this table.

and pleural surgery seemed to be safer for pulmonary complications.

Another crucial issue for minimally invasive surgery is reduced LOS. Regarding five AVATS studies, this approach seems to be mostly beneficial compared to thoracoscopic surgery with tracheal intubation.[9,10,19-21] Liu et al.[19,20] used AVATS for lung surgery (bullectomy, segmentectomy or lobectomy) in two different studies and reported significantly reduced LOS. The authors explained improved outcomes with avoidance of neuromuscular blocking agents and preventing muscle weakness due to residual effects of anesthetics. The second advantage appears to be manifest in gastrointestinal function which contribute to patients' recovery. The final issue - probably less investigated - is cytokine response which is proportionately initiated by extension of surgical stress. Limited to pleural surgery, Mineo et al.[21] underlined the advantage of maintained diaphragmatic contraction for rapid recovery as it prevents prolonged need for mechanical ventilation. Indeed, type of surgery affects seriously postoperative LOS. This issue has been well discussed in a recent paper for non-intubated VATS investigating the surgical risk.[11] Anatomical lung resection seems to be associated with longer LOS, and advantages of awake surgery is less remarkable for extended surgery.[10] In our study, LOS is about three days, consistent with the literature.[9,10,21] We believe that shorter surgery and relatively rapid chest tube removal contributed to reduced LOS. Our results are similar with previous non- major thoracoscopic surgery.[9,10,21] For the same surgical group, some studies reported more prolonged LOS.[11,19,20]

Advantages of AVATS with lesser incisions and minimal port use do not exclude the need for adequate analgesia considering thoracic innervation. Indeed, management of awake thoracic surgery offers two main challenges: adequate analgesia and, particularly, airway control. Pain control has been reported in a wide spectrum starting with local anesthetic infiltration to thoracic epidural block.[6] Intercostal nerve blockade and thoracic epidural block are mostly preferred regional techniques.[6] Thoracic chest wall blocks, local infiltration and paravertebral block are the other alternatives. Regional analgesia offers advantage of sparing anesthetic requirement and contribute to rapid recovery.[22] One of the large series used ICNB for AVATS with additional remifentanil infusion and authors declared occasional benzodiazepine requirement during surgery.[21] Recently, ICNB with propofol infusion was reported to be safe and appropriate for non-intubated lung surgery.[9] Interestingly, experience might change anesthetic management for AVATS, and the same group begun initially with thoracic epidural analgesia (TEA) and changed to ICNB due to time consuming nature, potential complications of epidural block.[10,19,20] Extent of surgery determines the certainly analgesic method; TEA can still be a reliable choice for major thoracoscopic surgery.[11] The authors preferred chest wall blocks for minor procedures. In our institution, the Surgery Team is very familiar with the ICNB which provides adequate analgesia for awake thoracoscopic surgery with an acceptable dose of midazolam and fentanyl. We can confirm that pain control with ICNB supplemented with light sedation can be achieve in a cooperate patient who is secure for the respiratory function.

For non-intubated thoracoscopic surgery, airway management varies largely between studies beginning with a face mask extending to laryngeal mask airway (LMA).[4-6] The choice of airway can be associated with institutional or local opportunities as well as patients' status. Considering anesthesiologist's perspective for non-intubated thoracic surgery, the authors highlighted national preference of LMA.[6] In one hand, LMA appears to reduce conversion to intubation; on the other hand, it is associated with "extemporaneous curarization". According to the literature review, lung resection with AVATS seems to be mostly associated with LMA.[10,11,19,20] We used face mask or nasal cannula; for both preservation of spontaneous ventilation is mandatory. Although supraglottic, airway instrumentation requires deeper anesthesia or even neuromuscular blockade. It can be easily confirmed that airway instrumentation can diminish expected advantageous of non- intubated thoracic surgery. Short operation time in our study group allowed light sedation with effective analgesia and prevented a need for more invasive airway tool. Less but not least, approximately one-third of the study group was assessed as high risk for PPC. Thus, it would be preferable to maintain respiration and to avoid residual anesthetic effects.

Nonetheless, this study has some limitations. First, this is a retrospective study which can be affected by inherent bias (acquired experience of the team throughout study time). Second, surgical aspect could be designed in a uniform manner such as pleural or parenchymal procedures. Increased risk is usually attributed to lung resection; however, larger controlled studies should be designed to conclude this issue. Third, a dedicated scoring system for thoracic surgery is still lacking. Most common systems such as ARISCAT and LAS VEGAS have been described for non- thoracic surgery. Recently, a novel risk assessment tool, namely CARDOT, has been developed.[23] We preferred ARISCAT, as it is considered a well-defined system and avoided LAS VEGAS as it examines mechanical ventilation parameters which would be inconsistent for this study. The SPORC has been also developed for non-thoracic surgery to predict respiratory failure and not focused on PPC. The CARDOT seems to represent an alternative in case of lung resection surgery, as it investigates postoperative pulmonary function. A very recent study examined abovementioned scoring systems and did not reveal superiority of each one.[24] Fourth, a homogenous study group of high-risk patients could be studied to assess effects of AVATS on pulmonary complications. We are currently planning a prospective study for vulnerable patients for PPC undergoing awake thoracoscopic surgery.

In conclusion, postoperative pulmonary complications are crucial for thoracic surgery and perioperative management would rather be tailored to prevent this issue. Risk assessment is another topic yet to be established. This is the first study among AVATS patients assessed by ARISCAT for postoperative pulmonary complications which found a trend of decreased incidence for low-risk group compared to high- risk one without a statistical significance. Moreover, the postoperative pulmonary complication rates were lower than predicted by the risk score which can be attributed to awake surgery.

Ethics Committee Approval: The study protocol was approved by the Istanbul University Istanbul Faculty of Medicine Ethics Committee (date: 10.09.2021, no: 2021/1506). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Patient Consent for Publication: All patients provided informed consent for AVATS after receiving an explanation of anesthesia type and surgical procedure.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

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