

# International VATS Experiences: Jordan

## Uluslararası VATS Deneyimleri: Ürdün

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### SUMMARY

*The specialty of thoracic surgery has witnessed in the past few years, an increasing number of innovations and extensive use of less invasive surgical techniques. The use of video-assisted thoracic surgery (VATS) is becoming the standard surgical method when managing pulmonary pathologies, especially non-small cell lung cancer in many medical centers around the world. In this paper, we describe the VATS adoption patterns internationally and then focus on our experience in VATS lobectomy in Jordan, Middle East. We also describe our current VATS lobectomy practice in terms of hospital setting, team structure, operating room setup with instruments used, anesthesia setup, pre and post-operative setup, fast-track priorities, and we discuss the difficult issue with VATS lobectomy.*

**Keywords:** VATS, lobectomy, Jordan, international, uniportal, thoracotomy.

### ÖZET

Göğüs cerrahisinin uzmanlığı son birkaç yılda, artan sayıda yenilik ve daha az invaziv cerrahi tekniklerin geniş kullanımına tanık olmuştur. Video yardımlı torasik cerrahinin (VATS) kullanımı, dünyanın dört bir yanındaki tıp merkezlerinde, özellikle küçük hücreli dışı akciğer kanseri olmak üzere, akciğer patolojilerini yönetirken standart cerrahi yöntem haline gelmektedir. Bu yazıda, uluslararası VATS adaptasyon modellerini, Ürdün ve orta doğudaki VATS lobektomi deneyimimizi değerlendirdik. Ayrıca VATS lobektomide hastane pratiğimizi, takım yapısını, kullanılan aletlerle ameliyathane kurulumunu, anestezi kurulumunu, ameliyat öncesi ve sonrası kurulumunu, hızlı takip önceliklerini ve VATS lobektomi ile ilgili zorlu durumları anlattık.

**Anahtar Kelimeler:** VATS, lobektomi, ürdün, uluslararası, uniportal, torakotomi.

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## Introduction

In 1992, the first VATS lobectomy incorporating anatomic hilar dissection was performed<sup>(1)</sup>. Despite the early start more than 27 years ago, adoption of the VATS technique in the early years has been slow, but recently there has been a growing interest and rapid adoption of VATS techniques to treat non-small cell lung cancer<sup>(2)</sup>.

Early skepticism towards the VATS approach by the surgical community was demonstrated by a survey performed in 1995. At that time, > 60% of the participating surgeons performed < 20% of their procedures through the VATS approach. Anatomical resections such as VATS lobectomies were considered to be unacceptable or investigational by 84% of the participating surgeons<sup>(3)</sup>.

In 2012, the Cross-sectional Survey On Lobectomy Approach study (X-SOLA study) involved 838 international thoracic surgeons, there was a paradigm shift in the inclination of surgeons regarding VATS procedures, as 92% surgeons who did not perform VATS lobectomy procedures reported that they wanted to learn the technique<sup>(4)</sup>. Moreover, the results of the most recent European study suggested that there is a strong trend favoring VATS for a range of thoracic procedures in the current clinical setting<sup>(5)</sup>.

The use of video-assisted thoracic surgery (VATS) is considered now the standard surgical method when managing pulmonary pathologies, especially non-small cell lung cancer in many medical centers around the world<sup>(6)</sup>. Nowadays, international and national guidelines suggest that VATS lobectomy is the technique of choice for the treatment of early-stage lung cancer<sup>(7,8)</sup>.

## International VATS Lobectomy Adoption Patterns

Due to many factors, the adoption rates of VATS lobectomy has varied widely between different countries. In the USA, nearly 1 in 3 NSCLC lobectomies are performed by the VATS approach, with wide variation between hospitals ranging from 1% to 76% of all cancer lobectomies<sup>(9)</sup>. In the Society of Thoracic Surgeons General Thoracic Surgery Database, the data demonstrated that approximately 50% of lobectomies in the USA are performed thoracoscopically<sup>(10)</sup>. However, there has been a great discrepancy in VATS practice among the European Countries.

Between 2010 and 2012, VATS procedures in Europe occupied 18.8% in lung resection, and the rates of VATS lobectomy was 11.3% across Europe.

Denmark showed the highest VATS resection rates (55%) in 2011, and the Copenhagen group had the largest VATS experiences among the European countries, while Surgeons in Great Britain and Ireland reported 14% at the same year<sup>(11)</sup>. More recently, the European Society of Thoracic Surgery Database reported that less than 25% of lobectomies are being performed thoracoscopically<sup>(12)</sup>. As for China, data of 7,693 patients from 17 tertiary hospitals across all of six geographic regions in China showed that the VATS lobectomy rate was 47.6% nationwide and varied widely from 14.0% to 74.5% across geographic regions and from 12.9% to 89.7% at the hospital level<sup>(13)</sup>.

## Hospital Setting

The setting for our current practice is in Jordan Hospital and Medical Center, a comprehensive 300-bed modern teaching hospital in Jordan, Middle east. The focus of the practice relies heavily on minimally invasive thoracic techniques to surgically treat the whole spectrum of thoracic surgical diseases. Currently, more than 85% of all thoracic surgery cases in our program are performed via minimally invasive approaches; this includes lung resections, diaphragm surgeries, esophageal surgeries, mediastinal surgeries and minimally invasive surgeries in selected trauma settings<sup>(14-16)</sup>.

## Team Structure

Our team is heavily centered around a multidisciplinary approach to each patient with lung cancer. The team consists of

**1. Consultant Surgeon:** Who is a double-board certified cardiothoracic surgeon (cardiothoracic surgery and general surgery). He is a fellowship-trained in Thoracic Surgery. He is also fellowship-trained in minimally invasive thoracic surgery.

**2. Assistant Surgeon:** Who is a Junior Board-eligible cardiothoracic surgeon (and board-certified general surgeon).

**3. General surgery resident:** As part of the general surgery residency program in our medical center, we always have a second or third-year resident rotating in the service for a period of three months each.

**4. Pulmonologist:** There are three busy pulmonologists in the hospital with a very wide referral base. The pulmonologists perform both diagnostic and interventional bronchoscopy procedures.

**5. Pathologists:** A senior consultant pathologist with a special interest in pulmonary pathologies along with a junior pathologist are available at the hospital with direct access to frozen sections studies during all surgeries.

**6. Radiologists (diagnostic and interventional radiologists):** In-house senior interventional radiologists, as well as a senior diagnostic radiologist, are available during the day-time. During night time and calls, there are three in-house junior radiologists with two radiology residents.

**7.** Infectious disease consultant.

**8.** Oncologist.

**9.** Respiratory therapy and physical post-surgery rehabilitation team.

Given that our main current practice is heavily focused on minimally invasive techniques, all of our team members ( Surgeon, assistant surgeon, and surgical residents) are very comfortable in less-invasive techniques. It is known that VATS can be technically more demanding compared to conventional thoracotomy<sup>(17)</sup>; this is why all general surgery residents are encouraged to learn the minimally invasive thoracic procedures early on in their training (in addition to more conventional techniques). In fact, it was found that surgeons with limited experience in open lobectomy can achieve good outcomes in VATS lobectomy comparable with their more experienced seniors<sup>(18)</sup>.

In addition to formal fellowship training in both thoracic and minimally invasive thoracic surgery, both the surgeon and the assistant surgeon in our team have been extensively trained in Uniportal VATS lobectomy (a rapidly growing VATS technique for lung cancer) by attending mini-fellowship programs in Shanghai Pulmonary Hospital, the largest pulmonary hospital in the world. The team surgeons were also involved in simulation VATS training, both on low-fidelity models, high fidelity models, and live animal wet labs. Add to that, great experience and knowledge exchange occurred at our program by inviting international and world-renowned surgical experts for live surgeries and masterclasses.

Currently, most of the VATS lobectomy cases in our program are done using the Uniportal VATS technique. This reflects a shift in our practice from a 3-port VATS technique more than six years ago to a Uniportal VATS. This shift goes along with the current understanding in the medical literature, where Uniportal VATS is a viable alternative approach to

the conventional VATS. In addition, when Uniportal VATS is compared with conventional VATS, Uniportal VATS has better safety and efficacy in the surgical resection of NSCLCs<sup>(19,20)</sup>.

## Anesthesia

For our VATS lobectomy cases, we have a senior anesthetist, an anesthesia resident, and an anesthesia technician in each case. Lung isolation is achieved by using either a double-lumen tube or a Rusch®EZ-Blocker™ (Teleflex, USA) depending on the preference of the senior anesthetist for the case. A flexible bronchoscope is used to confirm lung isolation in all cases, pre-operatively. We strive to provide a Quality-focused, cost-effective, patient-centered care and we tend to utilize a fast track protocol that relies on the best evidence-based practices such as thoracic Fast-track protocols, ERAS ( Enhanced Recovery After Surgery) protocols, and T-ERAA S (Thoracic-Early Recovery with Ambulation After Surgery) as described by Mayor et al.<sup>(21)</sup>. These protocols can improve patient outcomes and provide a cost-saving in VATS lobectomy<sup>(22)</sup>.

## Preoperative Workup

For all cases of lobectomy, a preoperative workup includes some or all of the following tests: ABG ( Arterial Blood Gases), Chest CT scan, PET scan, Mediastinoscopy, Pulmonary Function Test, V/Q Ventilation/Perfusion scan, CT-guided percutaneous drainage, Brain MRI, Chest Ultrasound ( which can reduce the incidence of lung injury during the initial port insertion during VATS by avoiding pleural adhesions<sup>(23)</sup>, and sometimes we utilize wire localization for small lesions and Ground Glass Opacities (GGO), which is safe, accurate procedure and aids in resecting small, deep, and impalpable nodules once they are localized with the wire<sup>(24)</sup>.

## Operating Room Setup

Surgeon and assistant position: Since most of the VATS procedures are carried out using the Uniportal approach, we found it more convenient to have both the surgeon and the assistant surgeon stand on the same side and have the nurse stand on the opposite side. We place the monitor opposite to the surgeons. In cases of multiport VATS, the surgeon and assistant surgeon stand on opposite sides.

**Surgical towers/monitors:** High definition surgical towers (Stryker®, USA, and Storz®, USA) are utilized in our service and are shared with the other minimally invasive surgical specialties in the hospital.



We use 30 degrees 10 mm lens for all our lobectomy cases, with occasional use of the Endocameleon multiangle lens (Karl Storz®, USA).

**Surgical Instruments:** We use double articulating VATS-specific surgical instruments from Scanlan® (USA) for all our VATS lobectomy cases. This double articulation mechanism allows for the use of several articulated instruments simultaneously via smaller incisions, which can be useful in Uniportal or Biportal VATS cases.

**Staplers:** In our practice, we exclusively use staplers from either Ethicon® (USA) or Covidien/Medtronic®, (USA) and tend to use tissue-specific endo staplers and powered staplers (Tissue and vascular). It has been shown that thoracoscopic lobectomy with powered and tissue-specific endoscopic staplers was associated with better clinical outcomes and reduced adjusted hospital costs when compared with standard staplers<sup>(25)</sup>. In general, for the parenchyma/fissure stapling and bronchus stapling, we use either Tristapler purple Covidien reloads, or green/blue Ethicon reloads. For the vascular structures, we use powered vascular stapler (Ethicon®), or tan vascular reloads (Covidien®).

**Ultrasonic Energy devices:** In our practice, we use ultrasonic energy devices in all cases of VATS lobectomy. In a prospective, phase 2, multicenter, international clinical trial, 150 patients planned for video-assisted thoracoscopic surgery/robotic anatomic lung resection in 7 centers (United States, Canada, United Kingdom) were enrolled. The authors concluded that pulmonary artery branch sealing with ultrasonic energy during video-assisted thoracoscopic surgery lobectomy is safe for vessels 7 mm or less<sup>(26)</sup>. Yet in our practice, any pulmonary artery branch larger than 4 mm is usually transected using a vascular stapler, or in selected situations, a polymer clip is used.

**Glues and hemostatic agents:** For air leaks from the parenchymal edges or fissures, we use Tissupatch® synthetic self-adhesive surgical sealant (Tissuemed, England). As for hemostatic agents, we have several options depending on the extent of oozing such as (Bioglue®, Bloodstop®, Surgicell®, Snow®, Fibrillar®, Perclot®).

**Wound protectors:** Since most of our VATS lobectomy cases are done via a Uniportal approach, we use Grena Wound Protectors (Grena®, UK) and Covidien® (USA) ports. They have rolling edges in an Alexis®-like fashion.

**Chest Drainage Bottles:** To have a better idea about the extent of post-lobectomy air leaks, we always use dry suction chest bottles (Atrium®, USA), with suction at -20 cm H<sub>2</sub>O, as suction at lower pressures is associated with a higher rate of reinsertion of chest tubes. Although it has been shown that removal of chest tubes with output amounts around 400-500 mL per 24 hours can be safe (27), in-out center, the chest tube is typically removed when there is no air leak, and the drainage is less than 250 mL per 24 hours. The chest tube is usually removed in a quick fashion with the immediate application of Vaseline gauze dressing. We don't typically close the chest tube opening with any sutures unless the patient is a very thing with no supporting subcutaneous tissue. The most recent literature regarding the use of digital drainage systems has suggested some potential benefits for the digital systems compared to conventional chest bottle drainage systems<sup>(28)</sup>, and in the future, if more studies confirm substantial benefits to digital systems, we might consider incorporating digital drainage systems in our practice.

### Postoperative Care

In summary, our post-operative fast track emphasizes the following points:

- Early ambulation within 3 hours of the procedure.
- We use intravenous (Patient Controlled Analgesia) PCA.
- We limit the narcotic use to the first 24 hours and continue with simple non-narcotic analgesia after the first 24 hours.
- We perform intraoperative multilevel paravertebral or an intercostal nerve block.
- We insert a single chest tube only after surgery.
- We aim for early removal of the chest tube (before postoperative day three), as it was shown that this achieves a greater reduction in the static pain score and greater improvement in FEV<sub>1</sub><sup>(29)</sup>.
- We remove monitoring lines in the first 24 hours.
- We encourage early feeding in the first few hours after surgery.

### Difficult Issues in VATS Lobectomy

**Learning curve:** Multidimensional statistical analyses suggested that the learning curve for VATS lobectomy for lung cancer required is around 26 cases (Figure 1)<sup>(30)</sup>.

**Figure 1. Formal training in minimally invasive thoracic surgery (The main Author Dr. Hamdi Abu Ali, the first from the left in the first row during his formal training in minimally invasive thoracic surgery training in Carolinas Medical Center, North Cartolina, USA in 2009. In the photo, Professor Francis Robicsek, the program director – The third person from the right in the first row).**



As for Uniportal lobectomy, the learning period of uniportal VATS lobectomy for a surgeon already performing conventional VASTS, would be approximately 30 uniportal VATS cases to reach the performance plateau level<sup>(31)</sup>. In order to achieve this, it is a good idea for any junior surgeon to start being comfortable with simple cases ( Bullectomy, lung wedge biopsies, early empyemas) before progressing to VATS lobectomy. The number of ports in VATS lobectomy should not be the main focus of the junior surgeon (Multiport, biportal, uniportal); although in our program, we shifted our practice from multiport to Uniportal and we feel that Uniportal VATS suits us more than other VATS techniques(Figure 2,3).

Difficulties leading to conversion to thoracotomy Conversion to thoracotomy should not be looked at as a complication, and thus the surgeon should be ready to convert to thoracotomy if indicated. Conversions to open thoracotomies occasionally occur, with an incidence rate ranging from 2% to 20%.<sup>(32,33)</sup>. Low-volume centers (< 100 cases) have an increased rate of conversion and complications compared with the intermediate-volume center and the high-volume centers. Issues with difficult local anatomy led most commonly to conversion across all levels of expertise, but more so in centers that had performed < 100 cases lobectomies, without clear difference between

centers that had performed 101-200 cases or over 200 cases. Nonetheless, serious intraoperative complications such as major bleeding may occur at any level of expertise, possibly due to a greater propensity of experienced surgeons to tackle more difficult cases by VATS<sup>(33)</sup>.

The most common reasons for conversion include unexpected vessel injuries and uncontrollable bleeding, intense hilar adhesions, and extensive disease progression to the hilum. Mal-manipulation of the hilar lymph nodes frequently leads to arterial injury and massive bleeding, which in most circumstances, requires open thoracotomy for bleeding control.

**“Scissor-first” technique:** In our practice, we tend to follow the “scissor-first” technique, as described by the shanghai pulmonary hospital (Figure 4)<sup>(32)</sup>. The focus is on using sharp dissection to find the right extra-bronchial space while keeping the artery intact with the calcified nodes. We try to minimize the use of electrocautery or energy devices and try to maintain a sharp dissection plane using scissors, which keep me safe along the bronchus. In addition, we sometimes suture across the nodes and then tie the small vessel branches. If the first run of the suture does not encircle the whole length of the vessel and there is resultant bleeding, another run of the suture can be done around the vessel to secure he-



**Figure 2. Inviting International VATS experts to perform a live operation at our medical center facilitates the transfer of knowledge and enhances VATS skills. In the photo Dr. Diego Gonzales-Rivas, a world-renowned Uniportal VATS expert during a visit to our medical center in 2015.**

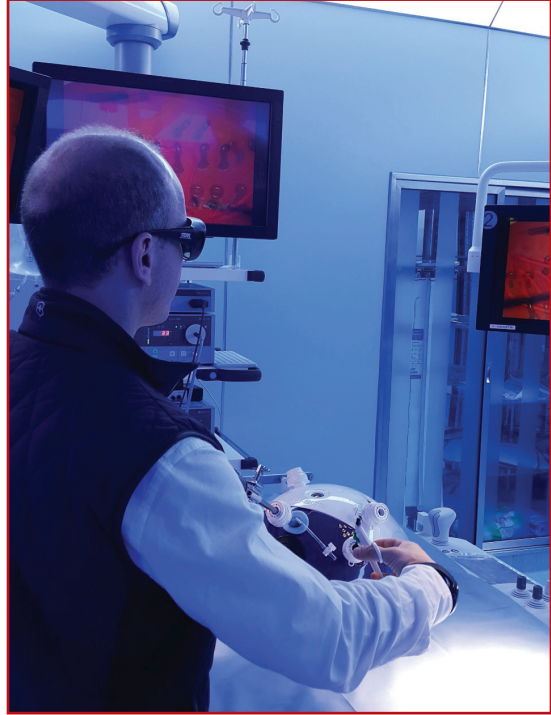


mostasis. Sharp dissection with the scissors tip directed downwards, continues to free the vessel from the bronchus along with the lymph nodes until the scissors meet the bronchus. This guarantees a safe dissection of the lymph nodes. This method can also be used to free the lymph node from the bronchus in a similar fashion to freeing the nodes from the artery as described above<sup>(32)</sup>.

### Conclusion

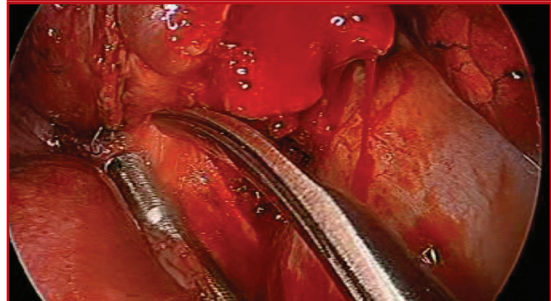
VATS lobectomy is currently considered the surgical method of choice for treating the early stages of Non-Small Cell Lung cancer worldwide. It is safe, oncologically sound, and provides significant advantages over conventional thoracotomy. With the availability

**Figure 3. Surgical VATS simulators, in the photo, one of our assistant surgeons – Dr. Baha Shihadeh, practicing on a dedicated VATS module simulator.**



of various methods to learn VATS such as structured training, observerships at high-volume VATS centers, utilizing surgical simulators, and going through the described learning curve, Surgeons from virtually any country in the world can perform a safe VATS lobectomy.

**Figure 4. “Scissor-first” technique in one of our post-chemotherapy male patients with right upper lobe Adenocarcinoma. This patient had fused hilum with calcific lymph nodes at the hilum with no clear plane of dissection. Note the downward direction of the tips of the scissors to try and dissect a plane between the calcific and fused hard lymph nodes and the hilar structures. The use of energy devices and cautery is being avoided as much as possible.**



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