

VATS Lung Resection in Bosnia and Herzegovina

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ABSTRACT

Background: Video-assisted thoracic surgery (VATS) for both minor and major thoracic procedures has become routine practice worldwide. In this study, we present our experience with multiportal and uniportal VATS (MVATS and UVATS) in Bosnia and Herzegovina (B&H). MVATS and UVATS procedures were performed in two B&H Clinical Centers: Tuzla and Sarajevo. The first MVATS procedure at Tuzla Clinical Center was conducted in 2004, and the first UVATS lobectomy was performed in 2019. At Sarajevo Clinical Center, the initial MVATS took place in 2005, and the first UVATS lobectomy was carried out in 2020.

Methods: We retrospectively analyzed 401 VATS procedures with prospective data, collected between 06/2017 and 04/2023. The VATS technique was employed for wedge resections, partial resections, lobectomies, and other types of resections, including metastasectomy.

Results: Out of the 401 patients, 242 (60.34%) were male, and 159 (39.66%) were female, with a mean age of 57.2 ± 23 years. The procedures consisted of 231 UVATS and 170 MVATS. Lobectomy was performed in 61 (15.21%) cases, wedge resections in 216 (51.37%), partial resections in 85 (21.19%), and other types of resections in 39 (9.72%) patients. The median duration of the procedure was 210 minutes for lobectomy, and 77.5 minutes for wedge and other types of resections. Major complications, such as bronchopleural fistula in 22 (5.49%) cases, wound infections in 20 (4.99%), atelectasis in 19 (4.74%), lung infiltrations in 15 (3.74%), and bleeding in 15 (3.74%) patients, were observed. The overall mean hospital stay for all procedures was 6.45 days.

Conclusion: Uniportal and multiportal VATS techniques are feasible and safe for various indications in thoracic surgery. VATS can be performed in middle-income countries such as Bosnia and Herzegovina with acceptable results, by thoracic surgeons experienced in general thoracic surgery.

Keywords: Video-assisted thoracic surgery (VATS), uniportal VATS, multiportal VATS.

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Introduction

For many years the VATS procedure was rejected for diagnostic and therapeutic purposes, until 1992 when Giancarlo Roviario decided to perform the first lung resection for surgically treating lung cancer through small incisions, using a screen, and avoiding rib spreading¹. This procedure gained acceptance due to its clinical benefits compared to conventional thoracic procedures, being associated with less pain, reduced general complications, and shorter hospital stays. The procedure was also adopted in Bosnia and Herzegovina (B&H), with the first VATS performed in Tuzla in 2004 by Krdzalic et al., and in Sarajevo in 2005. Initially, it was used for pleural effusion, pleurodesis, pleural and mediastinal biopsies, lung wedge resections, and mediastinal pathologies. Further development of the Multiport VATS technique led to Uniport VATS. In 1998, Yamamoto Hirai from Kobe University School of Medicine in Japan used Uniport VATS in 6 patients for minor thoracic surgery².

In 2010, Diego Gonzales-Rivas became the first in the world to perform a uniportal VATS lobectomy with radical lymphadenectomy for non-small cell lung cancer (NSCLC). He also conducted many complex procedures, including pneumonectomy, lobectomy, segmentectomies, tymectomy, bronchial and arterial sleeves, and chest wall resections through U-VATS^{3,4}. UVATS was implemented at Tuzla Clinical Center in 2015 by Krdzalic et al., marking the first use of this technique in B&H. The first lobectomies were performed at Tuzla Clinical Center in 2019, and in Sarajevo in 2020.

Intraoperatively, VATS maintains the oncological principles of traditional open surgery, and facilitates a fast postoperative recovery, enabling the earlier administration of adjuvant therapy^{5,6}. The latest development was a lobectomy in a non-intubated patient using uniportal VATS⁷. The implementation of the uniportal technique into clinical practice is spreading globally, with a strong focus on Uniportal Robotic Assisted Thoracoscopic Surgery (URATS) as the best basis for applying robotic techniques in European surgical centers. The clinical outcomes and results have been encouraging, and more long-term data are eagerly awaited. The purpose of this study was to analyze the experience with the VATS technique in B&H in order to contribute to the international medical database.

Patients and Methods

Between January 2016 and June 2023, we collected data from patients undergoing multiportal and uniportal VATS procedures at two Clinical Centers: Tuzla and Sarajevo. A total of 401 VATS procedures were included in this retrospective study. The demographic data for the patients are presented in Table 1. This study was approved by the review board at the University Clinical Centers in Tuzla and Sarajevo, and all patients provided written informed consent before surgery. These techniques were performed by thoracic surgeons experienced in the postero-lateral thoracotomy approach for major lung resections. We studied the results of uniportal and multiportal VATS in terms of morbidity, histology, TNM staging, length of surgery, and hospital stay.

Table 1. The demographic of patients

	Age (range)	No. Of pts.
Overall mean	54.7 (10-81)	401 (100%)
Sex		
Male	49.77 (38-81)	242 (60.34%)
Female	57.85 (10-71)	159 (36.66%)

Surgical Technique

All patients were positioned either on their right or left side, as for postero-lateral thoracotomy (Figure 1). General anesthesia with single lung ventilation was performed for all procedures. In MVATS, three incisions were most common. In all approaches, the 10mm camera port was typically placed low in the chest—7th or 8th intercostal space—and either in the mid or anterior axillary line. A second incision (3 to 4 cm) was usually placed in the anterior axillary line, around the 5th or 6th intercostal space in cases of upper or lower lobectomy. The third incision, commonly 10 mm in size, was placed either through the auscultatory triangle, high in the mid-axillary line, or low in the chest in the posterior axillary line. No rib spreading was used for any of the incisions in any case.

In uniportal VATS, the 3-5cm single incision was placed in the 5th intercostal space. The incision allowed the introduction of more than two instruments, alongside the scope, at the same time. No additional skin incisions were made for any purpose, such as the placement of the thoracoscope, suction, or graspers. Both the surgeon and their assistant stood in front of the patient. All specimens were removed directly with a grasper through the incision or with an Endobag. One 24 or 28 Fr chest tube was inserted into the posterior part of the incision, and was sutured to the anterior and posterior margins of the uniportal skin incision (Figure 1). In some cases, additional incisions were made for chest tube placement.



Figure 1. Incision and chest tube after UVATS.

Postoperative Management

Most of the patients were admitted to an intermediate care unit and later to the thoracic surgery department on the same day. Mobilization and physiotherapy for the patients began on the day of surgery, and they received opiate pain medication. Chest X-rays were performed on the day of the operation and on the first postoperative day. Thoracic drainage was removed without clamping or with a 12-hour clamping period when normal X-ray findings were observed. The absence of air leak and secretion below 100 mL within 24 hours was considered ideal.

Statistical Analysis

Parametric data are presented as mean values. We used SPSS v19 (SPSS Inc, Chicago, IL, USA) software, and the significance level for all analyses was set at a P value of less than 0.05.

Results

A total of 401 U&M VATS procedures were performed for different indications. Out of these, 242 (60.34%) were in males, and 159 (39.66%) were in females, with a mean age of 54.7 (range 10-81) years. The most common procedure was wedge resection, performed in 216 (51.37%) patients. Sixty-one (15.21%) lobectomies were included due to lung cancer, along with 85 (21.19%) partial resections and 39 (9.72%) other types of resections (Table 2).

Surgery Duration

The surgery duration was calculated from skin incision to wound closure, excluding the time needed for frozen sections for histological findings. The median operation time for all VATS procedures was 143.75 minutes (Table 3).

Histology

Among the patients, 108 (26.9%) had histological findings of NSCLC. Other histological findings included SCLC, different lung metastases, or no malignancy in 8 (1.99%), 67 (16.71%), and 206 (51.37%) of the patients, respectively (Table 4, 5 i 6).

Table 2. The most commonly performed procedures

	Tuzla CC	Sarajevo CC	All	p
No. of pt	244 (60.84%)	157 (39.15%)	401 (100%)	ns
MVATS	61 (15.21%)	109 (27.18%)	170 (42.39)	ns
UVATS	183 (45.63%)	48 (11.97%)	231 (57.60%)	p<0.05
Lobectomy	52 (12.96%)	9 (2.24%)	61 (15.21%)	p<0.05
Wedge res.	79 (19.07%)	137 (34.16%)	216 (51.37%)	ns
Partial res.	74 (18.45%)	11 (2.74%)	85 (21.19%)	p<0.05
Other types of resections	39 (9.72%)	0	39 (9.72%)	s

ns - non significant

s - significant

Table 3. The surgery duration and mean hospital day

Mean	Lobectomy TZ/SA	Wedge&otr	Mean L/Wedge	Overall
Surgery duration (min.)	165/255	65/90	210/77.5	143.75
Mean hospital stay (days)	7.9/5.53	6.7/6.8	6.15/6.75	6.45

Table 4. The histology

	Tuzla CC	Sarajevo CC	
AdenoCa	24 (5.98%)	40 (9.97%)	64 (15.96%)
PlanoCa	16 (3.99%)	5 (1.24%)	21 (5.23%)
Other PH	204 (50.87%)	112 (27.93%)	316 (78.80)

Table 5. Other histology findings

Malignant		Benign	
Nondifferentiated	12	Emphysema bullosum	65
Neuroendocrine	8	Pneumonia interstitialis	59
Carcinoid	3	TBC	33
Ca lucidocellulare	3	Sarcoidosis	21
Large cell carcinoma	4	Inflamatio – bronchiectasis	9
Carcinoma pleomorfe	1	Aspergilloma	6
Metastasis	67	Hamartoma	7
		M. Castelman	1
		Haemorrhagiae et necrosis pulmonum	5
	110 (27.43%)		206 (51.37%)

Table 6. Stages of complete resected lung cancer

Stage	Tuzla CC	Sarajevo CC	All
Stage I	10 (16.29%)	2 (3.27%)	12 (19.67%)
Stage II	27 (44.26%)	4 (6.56%)	31 (50.81%)
Stage III	13 (21.31%)	2 (3.27%)	15 (24.59%)
Stage IV	2 (3.27%)	1 (1.63%)	3 (4.91%)

Perioperative Complications

The most common complications included broncho-pleural fistula in 22 (5.49%) cases, wound infections in 20 (4.99%), atelectasis in 19 (4.74%), lung infiltrations in 15 (3.74%), and bleeding in 15 (3.74%) patients. Additional complications, such as conversion, effusion, empyema, paresis of n.laryngeus recurrens, injury of the n.phrenicus, and positive resection margin, are presented in Table 7.

Conversion and Mortality

Thirteen conversions (3.24%) occurred due to intraoperative and postoperative bleeding. Non-surgery related mortality was recorded for three patients who

suffered from severe cardiac disease with low preoperative ejection fractions of 10-20%.

Postoperative Management

The thoracic drainage was removed when the secretion volume was below 100 mL, and there was no air leak. Postoperative broncho-pleural fistulas were successfully treated conservatively. The mean hospital stay was 6.45±3.31 days.

Discussion

The typical nature of thoracic lung diseases and cancer has led surgeons to seek less invasive techniques

Table 7. Overall complications after VATS

BP fistula	22 (5.48%)
Wound infection	20 (4.98%)
Atelectasis	19 (4.73%)
Bleeding-hemothorax	15 (3.74%)
Infiltratio	15 (3.74%)
Conversion	13 (3.24%)
Effusio	10 (2.49%)
Empyema	5 (1.24%)
Paresis nn. Lar.recc.	5 (1.24%)
Laesio n.phrenicus	2 (0.49%)
Pntx	3 (0.78%)
R+	4 (0.99%)
	129 32.17%

for their treatment. VATS lung resection is a less invasive approach in thoracic surgery, and may be applied to the majority of thoracic surgery procedures, including lung, thoracic wall, mediastinal mass resections, and reconstructions^{8,9}. Moreover, non-randomized evidence has shown that minimally invasive techniques are feasible in thoracic surgery and associated with less postoperative morbidity and fast recovery, allowing the beginning of adjuvant therapy without delay when necessary⁵.

Twelve years after Giancarlo Rovario performed the first VATS procedure, the technique was also introduced in B&H (2004.), and from then until 2015, the 3-port VATS was the standard procedure for minor interventions, while the postero-lateral thoracotomy was the standard approach for major resections. The surgeries were conducted on the basis of the experience of the thoracic surgeon. A sudden increase in the application of VATS procedures in B&H began with the introduction of UVATS. This trend started in 2016, resulting in a significant reduction in the number of MVATS procedures. In Germany, this process began in 2012¹⁰. Especially during that time, there was a strong trend in research and the practice of uniportal VATS in Asia¹¹.

The first UVATS lung cancer lobectomy was performed in Spain, in 2010, in Germany, in 2014, and in Slovenia in 2015. This procedure was established in B&H in 2019, and initially was performed with laparoscopic and open surgery instruments. This resulted in a prolonged duration of surgery but at the same time the learning curve was rapidly advancing. Certainly, the use of such instruments for retraction and dissection during uniportal VATS major lung resection is possible but far from optimal. There are specifically designed uniportal VATS instruments available with a slight curvature¹².

Our report represents the B&H experience with VATS in a heterogeneous group, demonstrating its feasibility with a low conversion rate (3.24%) and a morbidity rate of (32.17%). In a German study, the median operation time for major lung resections, anatomical segment resections, wedge resections,

and others was 252, 114, 88, and 73 minutes, respectively, and the mean hospital stay was 8.3 ± 5.3 days. In our study, the length of surgery was 210 minutes for lobectomy and 77.5 minutes for wedge resections, with an overall mean hospital stay of 6.45 ± 3.31 days¹⁰.

VATS can be realized in middle-income countries such as B&H, but the lack of thoracoscopic equipment and instruments remains a persistent problem. What is encouraging is that Dr. Diego Gonzales is introducing this method to many low-income countries, opening up the possibility for the development of thoracic surgery worldwide.

The implementation of VATS technique into clinical practice is spreading globally. It appears to be the best foundation for applying robotic techniques in surgical centers all over the world because there is currently a strong focus on Uniportal Robotic Assisted Thoracoscopic Surgery (URATS) as the technique of the future.

Conflict of interests

The author has no relevant financial or non-financial interests to disclose.

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