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Uniportal Video-Assisted Thoracic Surgery (U-VATS): Experiences and Challenges in Oncologic Patients in the Dominican Republic

Hernán Oliu Lambert[1], Natalia Altagracia de la Cruz de Oliu[1], Ana María Nazario Dolz[2], Orestes Noel Mederos Curbelo[3]

[1]Department of Thoracic Surgery, Instituto Oncológico Regional del Cibao, Santiago de los Caballeros, Dominican Republic
[2]Department of Thoracic Surgery, Hospital Provincial Saturnino Lora, Santiago de Cuba, Cuba
[3]Department of Thoracic Surgery, Hospital Universitario Clínico Quirúrgíco "Comandante Manuel Fajardo", La Habana, Cuba
Email: dr.oliu@outlook.com

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Abstract

Introduction: Uniportal Video-Assisted Thoracic Surgery (U-VATS) has appeared as a promising, minimally invasive approach for thoracic oncology, offering benefits such as reduced trauma, shorter recovery times, and lower complication rates. However, its adoption in resource-limited settings faces challenges, primarily due to limited access to specialized equipment, training, and infrastructure. **Methods:** This retrospective study evaluated the outcomes of 138 oncologic patients who underwent U-VATS between 2020 and 2024 at two centers in the Dominican Republic. Patients included those with primary lung cancer, pulmonary metastases, or masses requiring diagnostic biopsy. Data was extracted from patient records including epidemiological variables and clinical variables, treatments, and complications. A descriptive analysis was performed to summarize the data. Frequencies and percentages were calculated to report demographic and clinical characteristics, types of procedures, and postoperative outcomes. **Results:** The study population was predominantly middle-aged, with a near-equal gender distribution. Most patients underwent lung biopsies (63%), followed by lobectomies (22.5%) and metastasectomies (14.5%). The overall complication rate was low, with only 2.1% experiencing wound infections or atelectasis. The majority (87%) were discharged within 24 hours. These findings underscore U-VATS as a safe and effective choice for thoracic oncology in this setting. **Conclusions:** U-VATS shows promising outcomes in oncologic patients in the Dominican Republic, proving its feasibility and safety in a resource-limited environment. However, widespread adoption requires investment in infrastructure, training, and insurance coverage. Phased implementation, public-private partnerships, and cost-benefit analyses could support broader accessibility and integration of U-

VATS, potentially improving patient outcomes and reducing healthcare costs in similar settings.

Keywords

Uniportal VATS, Thoracic Oncology, Lobectomy, Dominican Republic, Minimally Invasive

1. Introduction

The development and adoption of minimally invasive thoracic surgery have significantly transformed the treatment landscape for thoracic oncology patients worldwide. Among these advancements, uniportal video-assisted thoracic surgery (U-VATS) has appeared as a promising technique for thoracic procedures, noted for its reduced trauma, shorter recovery times, and lower rates of postoperative complications.

The evolution of thoracoscopy began with Hans Christian Jacobaeus, who in 1910 introduced the first thoracoscopy procedure using an adapted cystoscope and cannula to access the thoracic cavity. This pioneering technique allowed him to treat empyema through an artificial pneumothorax and perform closed extrapleural pneumonolysis [1], marking the start of minimally invasive thoracic interventions. Jacobaeus continued to refine and publish his findings on thoracoscopy, further detailing the procedure in 1923 [2]. Building upon these foundational innovations, the field of thoracic surgery has advanced substantially, culminating in the development of U-VATS. Initially pioneered in 2004 by Gaetano Rocco *et al.* [3], U-VATS enabled wedge resections and was after popularized globally by Diego González-Rivas, who extended its application to major lung resections by 2011 [4]. This single-incision technique has become an alternative to traditional multiport VATS and open thoracic surgery, offering a minimally invasive option for lung cancer treatment and other thoracic conditions. Despite its clear benefits, the implementation of U-VATS presents unique challenges in resource-limited settings, where access to specialized equipment, training, and infrastructure may be limited [5].

In recent years, U-VATS has gained traction in Latin America and the Caribbean, although the steep learning curve and necessary resources have constrained its widespread adoption. Nations like Argentina, Chile, and Brazil have reported initial successes with the technique [6]-[8]. The Dominican Republic became the second Caribbean nation, after Cuba, to introduce U-VATS in 2018, when Jonathan Vargas collaborated with González-Rivas to train local surgeons in performing U-VATS lobectomies, standing for a critical milestone in the development of thoracic surgery in the region [9]. However, the adoption of U-VATS in the Dominican Republic is still limited by factors such as the absence of national lung cancer screening programs, lack of funding for essential equipment, and restricted insurance coverage for minimally invasive techniques. Moreover, many studies

show that although U-VATS can lead to shorter hospital stays, fewer complications, and reduced overall healthcare costs, the first investment required for surgical tools and specialized training often restricts its accessibility in lower-income countries [10] [11]. The Dominican Republic continues to face challenges associated with resource allocation and policy limitations, which hinder the expansion of U-VATS. Despite these challenges, initiatives such as public-private partnerships, phased implementation, and the establishment of regional centers may support broader U-VATS adoption in developing healthcare settings.

This study aims to provide a comprehensive analysis of U-VATS in oncologic patients in the Dominican Republic, evaluating its outcomes, finding current challenges, and comparing these findings with other studies. This contributes to the growing body of literature on U-VATS in low-income countries, highlighting the adaptations needed to implement this surgical approach effectively.

2. Methods

This retrospective study evaluated the outcomes of 138 patients who underwent U-VATS in the Dominican Republic between 2020 and 2024 at the Instituto Oncológico Regional del Cibao and the Centro Cardio Renal del Cibao. Sample size was decided through consecutive sampling, including all eligible oncology patients who met inclusion criteria within the study period. This approach ensured a representative sample of U-VATS interventions performed at these centers.

Patients were included if they had a confirmed oncological diagnosis needing thoracic intervention, such as primary lung cancer, pulmonary metastases, or lung masses requiring diagnostic biopsy. Exclusion criteria included patients unsuitable for minimally invasive surgery, including those with extensive tumor burden or severe comorbidities that posed high surgical risks. Participant selection was conducted through a review of medical records at both institutions, finding all patients who met the above inclusion criteria. No added recruitment criteria were applied, as this was a retrospective, descriptive study, allowing for the inclusion of all eligible cases without selection bias.

Procedures included pulmonary lobectomy, metastasectomy, and lung biopsy, each performed under the standardized protocols of the participating medical centers. Data was extracted from patient records including epidemiological and clinical variables, treatments, and complications.

A descriptive analysis was performed to summarize the data. Frequencies and percentages were calculated to report demographic and clinical characteristics, types of procedures, and postoperative outcomes. This approach provided a clear overview of the patient population, and the outcomes associated with U-VATS in this setting.

3. Results

This study included a total of 138 patients who underwent U-VATS in the Dominican Republic between 2020 and 2024. The main findings derived from the

presented tables are detailed below. Table 1 provides the distribution of patients undergoing U-VATS according to epidemiological variables, offering a comprehensive overview of the demographic and health-related characteristics of the study population.

Table 1. Distribution of patients undergoing U-VATS according to epidemiological variables.

Characteristics		No.	%
Age rank	15 - 24	3	2.2
	25 - 44	35	25.4
	45 - 64	81	58.7
	65 - 74	13	9.4
	>75	6	4.3
Gender	F	67	48.6
	M	71	51.4
Smoking history	No	61	44.2
	Yes	77	55.8
Comorbidities	Asthma	2	1.4
	Ischemic heart disease	4	2.9
	Diabetes mellitus	17	12.3
	Hypertoroids	2	1.4
	Hypertension	28	20.3
	Hypertension and diabetes	2	1.4
	Non chronic disease	83	60.1
Cancer history	No	42	30.4
	Si	96	69.6

The predominant group of patients was in the 45 to 64 age range (58.7%), followed by the 25 to 44 age group (25.4%). About gender, the population was balanced, with 51.4% men and 48.6% women. These data suggest that U-VATS is primarily being applied in middle-aged patients, which is consistent with the higher prevalence of pulmonary and extrapulmonary neoplasms in this age group. The near-equal gender distribution shows a similar impact of these pathologies on both men and women.

The history of smoking was seen in 55.8% of patients, while 44.2% had no history of tobacco use. The high prevalence of smoking among patients reinforces the strong association between smoking and the incidence of lung cancer, which was the primary underlying pathology treated with U-VATS in this study.

The most common comorbidity was hypertension, present in 20.3% of the patients, followed by diabetes mellitus, which affected 12.3% of cases. The prevalence of these comorbidities aligns with the profile of older oncological patients, who

are at greater risk for both neoplasms and cardiovascular and metabolic conditions, potentially increasing the risk of postoperative complications.

Table 2. Distribution of patients undergoing U-VATS according to clinical variables, treatments, and complications.

Characteristics		No.	%
Cancer origin	Colon	5	3.6
	Uterus	29	21
	Laryngeal	1	0.7
	Breast	34	24.6
	Mediastinum	8	5.8
	Prostate	5	3.6
	Lung	47	34.1
	Soft tissues	8	5.8
	Thyroid	1	0.7
Surgical approach	Lung biopsy	87	63
	Lobectomy	31	22.5
	Metastasectomy	20	14.5
Airway management	Intubated	27	19.6
	Non-Intubated	111	80.4
Lymphadenectomy or lymph node sampling	No	111	80.4
	Yes	27	19.6
Cavity washout cytology	No	129	93.5
	Yes	9	6.5
Anesthesia type	General	63	45.7
	Peridural	75	54.3
Operative time (min)	<90	111	80.4
	≥90	27	19.6
Blood loss (ml)	<50	119	86.2
	≥50	19	13.8
Postoperative stay	24	120	87
	48	16	11.6
	>72	2	1.4
Pleural drainage	24 Fr chest tube	24	17.4
	14 Fr chest tube	114	82.6
Postoperative complications	Atelectasis	1	0.7
	Wound infection	2	1.4
	No	135	97.8

The distribution of clinical variables, treatments, and postoperative complications among patients undergoing U-VATS is essential for understanding the procedural outcomes. This information sheds light on treatment approaches and the incidence of complications within this cohort and is presented in Table 2.

Most patients underwent lung biopsy (63%), followed by pulmonary lobectomy (22.5%) and metastasectomy (14.5%). The predominance of biopsies suggests the importance of U-VATS as a diagnostic tool in the management of lung neoplasms, particularly in cases where histological confirmation is essential for therapeutic planning. The performance of lobectomies and metastasectomies confirms the feasibility of this minimally invasive approach for more complex interventions. Most patients weren't intubated and stayed awake during the U-VATS procedure.

A total of 97.8% of patients did not experience major complications. Only 1.4% developed wound infections, and 0.7% had postoperative atelectasis. The low complication rate proves the safety and efficacy of U-VATS in this group of oncological patients, even in a resource-limited setting, highlighting the reduced morbidity associated with minimally invasive surgery.

A total of 87% of patients were discharged within the first 24 hours after surgery, while only 1.4% needed a hospital stay of more than 72 hours. The short postoperative hospital stay reflects the benefits of U-VATS in terms of rapid recovery and reduced demand for hospital resources. Most patients used 14Fr chest tubes. This is a crucial factor for the sustainability of this technique in a healthcare system with limited resources.

4. Discussion

The results of this study suggest that U-VATS is a safe and effective surgical option for oncological patients in the Dominican Republic, with low complication rates and short hospitalization times. Despite these advantages, significant challenges are still on access to advanced technology and surgeon training in this technique. The broader adoption of U-VATS in the country requires improvements in hospital infrastructure and the expansion of training programs for specialized surgeons.

In the present series, most patients fell within the 45 to 64 age range, like findings reported in earlier studies such as that of Tosi *et al.* [12], which saw a predominance of middle-aged patients. Additionally, the gender distribution in this series shows a balanced representation between men and women, which is consistent with other studies, although some authors have reported a male predominance [12].

Most of the procedures performed in this series were lung biopsies, followed by lobectomies. This aligns with trends seen in studies such as Maqueda *et al.* [13] where the uniportal approach has been widely adopted for biopsies as well as more complex procedures, such as lobectomy. Notably, the uniportal approach has been successfully applied to a variety of procedures, reflecting its flexibility and effectiveness. In terms of operative times, most procedures were completed in less than

90 minutes, suggesting surgical efficiency comparable to international reports. Yan *et al.* [14] highlight that there is no significant difference in operative time between uniportal and multiportal approaches, further reinforcing the efficiency of the uniportal technique. The low rate of complications in this series, such as wound infections, aligns with earlier research findings, where U-VATS has been shown to offer advantages in terms of lower postoperative complication rates [15]-[17]. Li and Dai [15] reported a similar trend, noting that patients undergoing U-VATS experienced fewer complications and a quicker return to daily activities compared to multiportal approaches. This series also seen significant use of epidural anesthesia, like the approaches described by Gao *et al.* [17] who emphasized the benefits of regional blocks in reducing postoperative pain in uniportal surgeries. Furthermore, the use of non-intubated anesthesia techniques, as seen in most cases in this series, aligns with contemporary trends favoring a less invasive approach to airway management, as described by Kong *et al.* [18].

As seen, the total number of patients over four years is smaller than many series from developed hospitals around the world. For instance, compared to the Shanghai Pulmonary Hospital, which was the seat of a total of more than 17,000 thoracic surgeries performed during 2019, being most of them performed by U-VATS [19], the presented series is overwhelmingly smaller. However, in many series from low-volume centers or hospitals in low-income countries, these figures can be comparable. The lower number of cases in the Dominican Republic may be due to several factors:

-Many health insurance plans do not cover minimally invasive thoracic procedures, which results in patients being operated on with open surgery techniques.

-Some health insurance plans do not cover the necessary materials for U-VATS, such as endoscopic staplers, wound retractors, energy devices for cautery, and others.

-Inadequate insurance coverage is a significant obstacle to patient access. Long permission periods for adjuvant therapies and procedures also postpone or stop treatment.

-The absence of a national lung cancer screening program, which leads to patients often being operated on in late stages of the disease.

-Lack of adaptation of international guidelines to the country's reality, as well as the absence of coverage or prolonged authorization times for adjuvant treatments.

These elements tend to delay treatment or simply contraindicate it in patients who could otherwise be candidates for U-VATS.

Some of the possible remedies to these challenges would be to work on policy advocacy: Educating legislators on the advantages and disadvantages of covering U-VATS may promote wider coverage. Insurance firms may be able to make an economic case for it by presenting data on its lower rates of complications and quicker recovery times. The creation of subsidized Programs would Increase access to U-VATS for low-income patients. These benefits may be possible through

the development of subsidized programs or social insurance plans. Finally, the automatization of Simplified Authorization Procedures by working with insurers to shorten authorization wait periods, especially in emergency situations, would ease prompt action.

There are other significant challenges, primarily the poor access to advanced technology. U-VATS requires specialized equipment, including high-quality thoracoscopes, specific instruments, and high-definition video systems, which are limited in the Dominican Republic, particularly in centers outside major cities. The high cost of getting and supporting this technology can be a significant barrier to its implementation in public and private hospitals with lower economic capacity. Not all hospitals in the Dominican Republic have the adequate infrastructure to perform minimally invasive surgeries, which includes well-equipped operating rooms and specialized intensive care units for postoperative management.

High-definition thoracoscopes, energy devices for cautery, endoscopic staplers, and other surgical instruments are among the sophisticated and specialized tools needed for U-VATS. This equipment can be excessively expensive to get and support, and it is sometimes unavailable or only available in major cities in the Dominican Republic. The infrastructure needed to do minimally invasive procedures, such as well-equipped operating rooms and specialist post-operative care units, is lacking in hospitals found outside of major cities.

Workable solutions to this challenge are:

-Government and institutional investment: It is essential that the government and healthcare organizations make targeted investments. Investing in the acquisition and maintenance of U-VATS equipment may contribute to its expansion.

-Public-Private Partnerships (PPPs): By involving private organizations in collaborations to finance infrastructure and technology advancements, expenses can be distributed and accessibility improved.

-Shared resources across facilities: With specialized equipment, regional hubs can provide several healthcare facilities, especially in lower-income and rural locations. This enables more extensive access without incurring duplicate costs.

Additionally, the learning curve for U-VATS is steep, requiring specialized surgeons with specific training in this technique. Therefore, the implementation of continuous training programs through local workshops led by thoracic surgeons trained abroad—who remain few to date—is necessary. This learning curve also applies to anesthesiologists specialized in pulmonary surgery, of which there are few in the country.

It is also important to note that not all oncological patients are ideal candidates for U-VATS, and proper patient selection is crucial for the success of the procedure. Complex cases or large tumors may present more challenges.

In some cases, patients and their families may resist accepting new or less-known procedures, preferring more traditional techniques. This may require more efforts in education and communication to explain the benefits of U-VATS.

Finally, there is a scarcity of local studies and clinical data supporting the

effectiveness and safety of U-VATS in Dominican oncological patients, which could limit the adoption of the technique. It is therefore essential to promote local research to evaluate the specific outcomes of U-VATS in oncological patients in the country and to adapt international guidelines to the Dominican context.

In several countries, the implementation of U-VATS has met significant challenges, primarily related to the learning curve. In Argentina and Chile, authors have emphasized that, although the first results were promising, the adoption of these minimally invasive techniques has needed a prolonged learning phase. This is because the procedures are technically demanding, and their successful execution largely depends on the accumulated experience of the surgical team [20] [21]. Furthermore, the involvement of international experts, such as Dr. Diego González Rivas, has been crucial for knowledge transfer, helping to overcome some of these barriers, particularly in Chile [22].

The lack of adequate training has been a recurring obstacle in Brazil and the Caribbean. In Brazil, authors have pointed out that limited infrastructure and difficulties in accessing specialized equipment have slowed the widespread adoption of U-VATS [8] [23]. Similarly, in the Caribbean, financial constraints and a shortage of necessary equipment have restricted the ability of many centers to implement minimally invasive techniques [24]. This lack of specialized training and infrastructure has also been identified as a major barrier in Cuba, where U-VATS is only beginning to be implemented [25].

Another challenge mentioned in studies from Cuba and Uruguay is the need for conversions to open surgery due to intraoperative complications, reflecting a lack of experience in managing these cases [25] [26]. In Uruguay, authors reported a conversion rate of 15%, highlighting the need for greater experience and training, particularly in low-volume centers, where the limited number of cases makes it difficult to get the necessary skills for performing more complex procedures [26]. These factors underscore that while U-VATS offers many benefits, its effective implementation depends on an environment that supports both skill development and access to adequate resources.

The advantages of U-VATS, including shorter hospital stays, faster recovery, and reduced complication rates, present substantial economic benefits. When compared to open thoracic surgery, U-VATS may decrease overall healthcare costs by reducing the length of hospitalizations, minimizing postoperative care, and lowering expenses related to managing complications associated with open procedures. Studies show that U-VATS can achieve high surgical efficiency with fewer postoperative complications, which translates to potential cost savings for healthcare systems [27]. However, the first investment needed for U-VATS-specific equipment and the necessary specialized training is still significant, presenting a barrier to immediate accessibility in resource-limited settings [6] [8] [9] [20] [21] [26]. While the analysis of cost-effectiveness highlights the economic benefits of U-VATS, several strategies for cost management are essential to overcome the financial barriers associated with its implementation in resource-limited settings.

-Incremental investment and phased rollout: Implementing U-VATS initially in high-volume centers allows for incremental cost absorption while generating essential data to support wider adoption. A phased approach eases data collection on cost-effectiveness, enabling healthcare providers to present evidence-based justifications for future expansion [28].

-Cost-benefit studies: Conducting detailed cost-benefit analyses to quantify potential savings in hospitalization and postoperative care, as compared to open surgery, can reinforce the long-term cost-effectiveness of U-VATS. Such data would provide a compelling case for policymakers and funding bodies to support U-VATS adoption [11] [28].

-Donations and equipment leasing: Collaborating with international health organizations for equipment donations or exploring leasing options can help offset capital costs, making U-VATS an available option for institutions with limited financial resources [29] [30].

The successful integration of U-VATS into the Dominican healthcare system will require robust policies focused on resource allocation, workforce development, and health insurance reform. Policymakers should prioritize health sector investments that promote minimally invasive techniques in oncology, which have shown potential to improve patient outcomes and reduce healthcare costs over time. Additionally, expanding lung cancer screening programs could allow for earlier diagnoses, making patients more likely to qualify for U-VATS. Finally, as local healthcare institutions gradually build capacity, continued collaboration with international thoracic surgery societies could provide ongoing technical support and knowledge transfer.

5. Conclusion

This study shows that U-VATS is a practical, safe, and effective option for oncologic patients in the Dominican Republic, providing benefits such as low complication rates and short hospital stays. Despite these advantages, significant challenges limit the widespread adoption of U-VATS in resource-limited settings. These barriers include restricted access to advanced technology, specialized training for surgeons, and necessary infrastructure improvements. Incremental strategies, such as phased implementation in high-volume centers, public-private partnerships, and collaborations with international health organizations for equipment donations, could help overcome these obstacles and help broader accessibility. The findings also highlight the potential economic advantages of U-VATS in reducing healthcare costs through shorter hospital stays and lower postoperative care demands. However, the substantial first investment in specialized equipment and training is still a challenge. Addressing this through detailed cost-benefit studies and advocating for policy changes, such as expanded healthcare coverage for minimally invasive techniques, could promote U-VATS adoption. Expanding lung cancer screening programs and setting up regional U-VATS centers would support earlier diagnoses and improve patient outcomes, ultimately strengthening

the Dominican healthcare system's ability to deliver high-quality, minimally invasive care.

6. Limitations of the Study

The study's limitations include its retrospective design, the potential for selection bias due to the inclusion of only patients meeting specific eligibility criteria, and its restriction to two centers, which may limit the generalizability of the findings across other healthcare facilities in the Dominican Republic. Additionally, the short study period constrains the ability to assess long-term outcomes, including cancer survival, recurrence, and overall cost-effectiveness. This limited follow-up period restricts a full evaluation of the economic benefits of U-VATS, such as potential cost savings from shorter hospital stays and reduced complication rates, within the Dominican healthcare context.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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