



Uniportal video-assisted thoracoscopy in pediatrics—initial experience

Firas Emad Abu Akar^{1,2}, Nisreen Rumman³, Bisanne Shaqura¹, Ahmad Shaltaf⁴, Murad Hemadneh⁴, Mayar Idkedek², Hasan Al-Khatieb¹, Helmi Tamimi¹, Adnan Farhood⁵, Fidaa Hammouda⁴, Abeer Dar Hasan⁴, Diego Gonzalez-Rivas⁶, Nizar Hijeh¹

¹Department of Cardiothoracic Surgery, Al-Makassed Charitable Society Hospital, East Jerusalem, Palestinian Territories; ²Department of Medical Research Club, Faculty of Medicine, Al-Quds University, East Jerusalem, Palestinian Territories; ³Department of Pediatrics, Al-Makassed Charitable Society Hospital, East Jerusalem, Palestinian Territories; ⁴Department of General Surgery, Al-Makassed Charitable Society Hospital, East Jerusalem, Palestinian Territories; ⁵Department of Anaesthesia, Al-Makassed Charitable Society Hospital, East Jerusalem, Palestinian Territories; ⁶Department of Thoracic Surgery, Shanghai Pulmonary Hospital, Tongji University School of Medicine, Shanghai, China

Contributions: (I) Conception and design: FE Abu Akar, N Rumman, A Farhood, N Hijeh; (II) Administrative support: FE Abu Akar, N Hijeh, N Rumman, A Shaltaf, A Farhood, D Gonzalez-Rivas; (III) Provision of study materials or patients: FE Abu Akar, A Shaltaf; (IV) Collection and assembly of data: FE Abu Akar, B Shaqura, M Hemadneh, M Idkedek, H Al-Khatieb, H Tamimi, F Hammouda; (V) Data analysis and interpretation: FE Abu Akar, M Hemadneh, B Shaqura, M Idkedek, H Al-Khatieb, H Tamimi, F Hammouda, A Dar Hasan; (VI) Manuscript writing: All authors; (VII) Final approval of manuscript: All authors.

Correspondence to: Firas Emad Abu Akar, MD. Associate Professor, Department of Cardiothoracic Surgery, Makassed Charitable Society Hospital, 28 Raba'a Adaweieh Street, Mount of Olives, East Jerusalem 90917, Palestinian Territories. Email: firasabuakar@gmail.com.

Background: It has become apparent that the endoscopic surgeries are rapidly developing, and they have become an essential part of every specialty of surgery. Single port thoracoscopic surgery is developing, enhancing the advantages of multi-portal video-assisted thoracoscopic surgery (VATS). Although becoming a well-recognised approach for adult patients, extremely limited literature exists concerning uniportal VATS among pediatric cases. This study aims to present our initial experience with this approach in a single tertiary hospital and extrapolate its feasibility and safety in this specific context.

Methods: Perioperative parameters and surgical outcomes for all pediatric patients who underwent an intercostal or subxiphoid uniportal VATS surgery in our department in 2 years retrospectively reviewed. The median length of follow-up was 8 months.

Results: Sixty-eight pediatric patients underwent different uniportal VATS operation for different types of pathology. The median age was (3.5 years). Median operating time was 116 minutes. Three cases converted to open. The mortality rate was zero. The median length of stay was 5 days. Three patients presented complications. Three patients lost from follow-up.

Conclusions: Despite literature data heterogeneity, these results provide support to the feasibility and applicability of uniportal VATS in the pediatric population. Further studies are required to explore the benefit of uniportal over multi-portal VATS (including chest wall deformities, cosmesis and quality of life).

Keywords: Uniportal VATS in pediatrics; single port thoracoscopy in pediatrics; pediatrics thoracoscopy

Submitted May 10, 2022. Accepted for publication Apr 02, 2023. Published online May 09, 2023.

doi: [10.21037/tp-22-216](https://doi.org/10.21037/tp-22-216)

View this article at: <https://dx.doi.org/10.21037/tp-22-216>

Introduction

The evolution that took place in the last two decades in the field of thoracoscopic surgeries was notable, especially with the entry of the uniportal video-assisted thoracoscopic surgeries (VATS) technique into the game as a least invasive technology. It has found exceptional popularity among adult thoracic surgeons; however, it is still not widespread in pediatric surgery. It has not widely applied in the same way that happened in adults. Rodgers reported the first employment of VATS for pediatrics in the late 1970s (1). Since the early 1990s, Rothenberg and his colleagues have published several series on their experience of multi-portal VATS lobectomy in pediatric patients (2,3). Until the time of writing this paper, the employment uniportal VATS surgeries in pediatrics limited to some case reports or small series (4-8). After we gained expertise in adult uniportal VATS, we sought to employ this technology in the pediatric field, believing this can enhance patient care and decrease morbidity. We present this article in accordance with the STROBE reporting checklist (available at <https://tp.amegroups.com/article/view/10.21037/tp-22-216/rc>).

Methods

In the period between July 2017 to July 2019, all patients with lung pathology requiring surgical intervention considered for a uniportal VATS approach. Demographics detailed in (Table 1).

Highlight box

Key findings

- Although challenging, uniportal video-assisted thoracoscopic surgery (VATS) is feasible and applicable among the pediatric population.

What is known and what is new?

- The existing literature concerning the application of uniportal VATS in pediatrics is extremely limited. Here, we represent our initial experience in which we describe the uniportal VATS technique and its results in children.

What is the implication, and what should change now?

- This study shows that with experienced hands, the uniportal VATS techniques can be used safely in pediatrics. Further studies are required to explore the benefit of uniportal over multi-portal VATS (including chest wall deformities, cosmesis and quality of life).

Statistical analysis

Statistical analysis is univariate and descriptive with frequency and percentage. It was performed using the statistical package IBM SPSS [2011] statistics program for (Windows Version 23.0). The hospital's electronic system of clinical records was used to investigate the cases.

The patients excluded were those with an unstable condition or when it failed to achieve lung separation. Ages of the patients ranged from 2 weeks to 18 years of age (median: 3.5 years) and weight from 2.3 to 72 kg (mean: 14.6 kg). Pathological diagnosis included decortication and/or empyema evacuation in 14 patients, mediastinal mass biopsy in 10, hydatid cyst in 4, sequestration in 2 or congenital adenomatoid malformation (CCAM) in 3, carcinoid tumour in 1, pleuropulmonary blastoma in 1, metastatic sarcoma in 1, lobar emphysema in 5 patients, neglected foreign body in 1, sympathectomies in 7, blebectomy and pleurodesis in 6, bronchiectasis in another 4, with other 9 miscellaneous cases (Table 2).

Technique

All the surgeries conducted under general anaesthesia and the lung isolation achieved via double-lumen intubation in patients weighting >30 kg or 8 years according to what was mentioned in Seefelder study (9). In contrast, contralateral main-stem bronchial intubation applied in newborns and patients weighting <30 kg under the guidance of the fiberoptic bronchoscopy. Arterial lines and peripheral intravenous (IV) access used as a routine. The patients positioned on lateral decubitus position in both intercostal and subxiphoid techniques with two overlapped towel sheets supporting both sides and an additional rolled towel was put under the axilla to enhance the intercostal space (Figure 1). The primary surgeon placed anterior to the patient, the assistant and the scrub nurse stands at the opposite side while the screen placed over the head of the patient (Figure 2). The incision performed at the anterior axillary line in the level of fifth intercostal space 2–3 cm in length. In the subxiphoid cases, we made a longitudinal incision over the xiphoid process (Figure 1). Insertions of the rectus muscles to both costal arches divided and the xiphoid cartilage removed. Wound protector standardly applied. 30°/5-mm or 30°/10-mm video thoracoscope used depends on the size of the intercostal space. All the instruments and the

Table 1 Demographics of the patients

Demographics	Values
Age	
2 weeks–18 years	Median: 3.5 years
Sex, n [%]	
Male	39 [57]
Female	29 [43]
Main presenting symptoms	
Cough	29
Dyspnea	18
Recurrent chest infections	19
Accompanied cardiac abnormality, n [%]	5 [7]

Table 2 Pre-operative diagnosis

Diagnosis	Number of patients
Empyema	14
Bronchial neoplasm (carcinoid)	1
Pleuro-pulmonary blastoma	1
Metastatic sarcoma	1
Mediastinal mass	10
Lobar emphysema	5
CCAM	3
Sequestration	2
Neglected FB	1
Hydatid cyst	4
Sympathectomy	7
Subpleural blebs	6
Bronchiectasis	4
Others	9

CCAM, congenital adenomatoid malformation; FB, foreign body.

thoracoscope introduced through the same incision. In older children, we utilized the standard uniportal VATS instruments designed for adult patients; however, in small patients and infants, we ought to use the conventional infant thoracotomy instruments (*Figure 3*). Trocars, carbon dioxide gas or additional incisions never needed in any of our surgeries except sympathectomies.

Thoracoscopic linear staplers (10 mm diameter Endo

GIA™ with Tri-Staple™ Technology) were used as 5 mm staplers are not available in our clinic. Due to the limited pleural space and the difficulty of inserting the stapler, we find ourselves obliged to use metal or polymer clips or to ligate the blood vessels. In other occasions, we use the energy device to divide the small vessels. If the bronchus could not be stapled, it has been cut and sutured with absorbable sutures. At the end of the resection, the specimen brought out through the same incision inside a protective bag. One case of left upper sleeve lobectomy was performed with the same principles as in adults, with one difference sewing the anastomosis with 4-0 polydioxanone (PDS) suture instead of 3-0. Sympathectomies performed via bilateral 1 cm incision at the mid-axillary line of the 3rd intercostal space; 10 mm 0 degrees thoracoscope with working channel introduced through the incision and carbon dioxide insufflated. The sympathetic chain identified and cauterized at two levels (usually T2, T3). In this particular procedure, we use a single lumen intubation. In patients with lobar emphysema, we start the surgery by puncturing the emphysematous lobe in order to obtain a good deflation and a better room for the instruments. In cases of hydatid cyst, we follow the same roles as in adult surgeries. Parenchymal sparing technique “Cap tonnage” should be performed whenever it is possible. One chest tube (12–20 Fr) is usually inserted through the same incision and fixed at the anterior portion of the incision in case of intercostal or fixed in the inferior portion of the incision in subxiphoid cases. The surgical wound closed in layers.

Ethical statement

The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The ethical approval and informed consent were waived by the ethics committee of Al-Makassed Charitable Society Hospital because data were collected anonymously and retrospectively from the hospital's data.

Results

Of 68 cases, 65 completed with uniportal VATS technique. No conversions to multi portal VATS recorded. However, conversion into anterior thoracotomy in 3 cases (4%) was mainly due to intricate instrumentation.

Operative times ranged from 25–188 minutes (median: 116 minutes). Intra-operative blood loss was 5–250 cc (median: 45 cc).

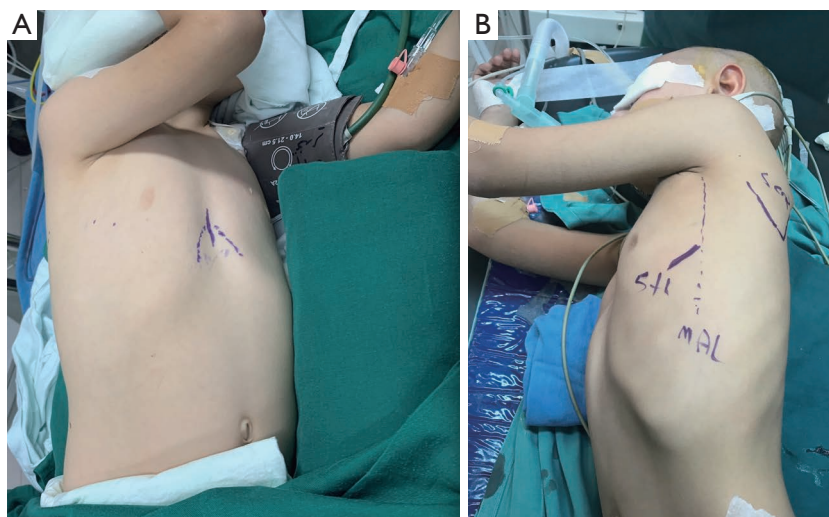


Figure 1 Position of the patient during the surgery and site of the incision for intercostal uniportal approach (A) and subxiphoid approach (B).



Figure 2 Location for the surgeon (right), assistant (left), scrub nurse (left) and the screen (above the head of the patient).



Figure 3 Conventional thoracotomy instruments used for infant uniportal VATS surgeries. VATS, video-assisted thoracoscopic surgeries.

Two patients (3%) had prolonged air-leak (beyond the fourth postoperative day), one of these two was after cap tonnage of hydatid cyst which had a small broncho-pleural fistula which closed spontaneously one week after the operation. The other patient had a prolonged air-leak after right lower lobectomy, which also stopped after 9 days with conservative treatment. Chest tube duration was between 1–9 days (median: 2 days). We had no cases of re-exploration or re-intubation. One patient developed pneumonia after the surgery treated with IV antibiotics. Length of stay ranged between 1–14 days (median: 5 days). Thirty days or intra-hospital mortality was zero.

Discussion

It has become apparent that the endoscopic surgeries are rapidly developing, and they have become an essential part of every specialty of surgery. The history of VATS goes back more than a hundred years when Jacobeus used a cystoscope to treat pleural adhesions in patients with tuberculosis (10). Many years passed after that, and thoraco-scopic surgery did not evolve so much, until with the beginning of the nineties, as endo-scopic cameras began to develop and became high definition cameras, which facilitates our work and makes it more accurate and safe (11). With the beginnings of the new millennium, reports began to arise about developing the science of thoracoscopy and making it less and less invasive by replacing multiple incisions with a single small incision to perform the surgery with the so-

called uniportal VATS technique (12-15). According to our experience, no major or minor changes in chest shape were noted after subxiphoid uniportal VATS surgeries. This technique has developed very quickly in adult surgeries, and many surgeons and centers around the world have adopted it as a standard technique for most of the thoracic surgeries even in complex ones (16-18). Perhaps the most significant credit for this goes to the founder of the technology, Mr. Gonzales-Rivas. For the outstanding effort, he puts into developing, teaching and spreading the technique around the world.

Nevertheless, the development of uniportal VATS in pediatrics did not go parallel to that in adults. Since Rodgers published in the seventies his first paper on the use of thoracoscopy in children (1), the technique has not been much developed. Most centres in the world still adopting traditional thoracotomy as a standard technique in pediatrics. When reviewing the literature of uniportal VATS, many studies and articles that describes the technique and results of uniportal VATS technique in adults could found, which has become state of the art in thoracic surgery. In contrast, pediatric surgery literature is almost devoid of this technique except for some case reports (4-8).

We think that the reason for this arises from several factors, the most important of which is that pediatric thoracoscopic surgery in children is more demanding and challenging than in adults due to the small space of the thoracic cavity and the limited mobility makes the instrumentation much more difficult (8). Besides, many systems classify pediatric thoracic surgery under the specialty of pediatric surgery instead of general thoracic surgery; this may be a hindrance for thoracic surgeons to practice this technique on children. Though, at the same time, pediatric surgeons may be unable to apply this technique due to lack of training on the uniportal VATS technique which must be mastered and practiced on adults first before the pediatric patients. However, we believe that pediatric thoracic surgery should be performed using the “least possible” invasive techniques. In addition to the well-known advantages of minimally invasive procedures such as the cosmetic aspect, decreased pain level, reduction of postoperative complications and quick recovery. There are advantages of paramount importance not present in adult surgeries and are specific to pediatrics. It is known that conventional thoracotomy may cause spinal scoliosis, asymmetric growth of the breast in growing children (19,20). This may cause of physical and psychological harm to the child, principally since most children who undergo thoracic

surgery suffer from benign diseases and have a long-term life expectancy, the long-term results of surgery should be looked at and taken seriously. After we received extensive training in an ultra-high volume VATS center (21), we gained experience in the uniportal VATS operations in adults. We decided to apply the technique to pediatric patients. At the beginning of our learning curve, simple operations such as biopsies and sympathectomy performed. We were passing through more difficult operations such as the anatomical resections, up to the complex operations Like a sleeve lobectomy and subxiphoid lobectomy (4,8). We are still at the beginning of our learning curve for the subxiphoid approach in pediatrics (7). We have found some advantages, especially the upper lobectomies as it provides a larger space for instruments in contrast to the very narrow intercostal space in children. Besides, to more comfortable angles for the staplers to divide the hilar structures provided by the subxiphoid approach.

Conclusions

The uniportal VATS technique has proven to be safe and feasible in most of adult thoracic operations. However, the technique still in beginnings for pediatrics. This study shows that with experienced hands, the technique can be used safely in pediatrics. Prior experience in this type of operation in adults appears mandatory before applying in children. Designing instruments for this type of operation is an urgent necessity to improve performance and facilitate the conduct of these operations. Further studies are required to explore the benefit of uniportal over multi-portal VATS (including chest wall deformities, cosmesis and quality of life).

Acknowledgments

Funding: None.

Footnote

Reporting Checklist: The authors have completed the STROBE reporting checklist. Available at <https://tp.amegroups.com/article/view/10.21037/tp-22-216/rc>

Data Sharing Statement: Available at <https://tp.amegroups.com/article/view/10.21037/tp-22-216/dss>

Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at <https://tp.amegroups.com/article/view/10.21037/tp-22-216/cif>)

[com/article/view/10.21037/tp-22-216/coif](https://doi.org/10.21037/tp-22-216/coif)). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The ethical approval and informed consent were waived by the ethics committee of Al-Makassed Charitable Society Hospital because data were collected anonymously and retrospectively from the hospital's data.

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Cite this article as: Abu Akar FE, Rumman N, Shaqqura B, Shaltaf A, Hemadneh M, Idkedek M, Al-Khatieb H, Tamimi H, Farhood A, Hammouda F, Dar Hasan A, Gonzalez-Rivas D, Hijeh N. Uniportal video-assisted thoracoscopy in pediatrics—initial experience. *Transl Pediatr* 2023;12(5):800-806. doi: 10.21037/tp-22-216