

Future study direction on single port (uniportal) VATS

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Single port or uniportal VATS (uniVATS) has represented an authentic innovation in the setting of the surgical techniques because it has connected the past of a single thoracotomy approach to address all conditions in the chest to a present of patient fast tracking and reduced morbidity for all procedures (1). Unlike a few years ago, skepticism about uniVATS has disappeared to be replaced by solid conviction of feasibility (2-5). Is this enough to warrant widespread application of this technique? The future of clinical research on uniVATS will have to clarify and address (I) the results of uniVATS in terms of morbidity (i.e., pain) and oncological value compared to the current technical standards; (II) the new dedicated and ergonomic surgical dissection instruments gauged to fit the single port should be devised along with a new method of visualization (i.e., 3D) and the possible utilization of safe and effective energy devices for the closure of pulmonary vessels; (III) the use of uniVATS in hybrid OR's along with the use of the principles of navi-uniVATS—similar to endobronchial navigation; (IV) the resort to robotic uniVATS and NOTES and uniVATS through awake and nonintubated anesthetic management; (V) the assessment of patient satisfaction after uniVATS, modalities of uniVATS teaching, and, last but not least, cost effectiveness of uniVATS.

The interest raised by single port or uniVATS has been in the past decade focused on the potential feasibility of this technique. The present and the future will be about evaluating the outcomes in terms of postoperative morbidity and 90-day mortality on large datasets (6-10). In addition, the oncologic value of this approach is most likely to be confirmed since the intraoperative maneuvers are similar to the ones performed either in open (mini)thoracotomy or three-port VATS (11). However, there are some issues

that in the future may shift the opinion towards uniVATS and finally convince the skeptics about the important role of single port VATS in the current thoracic surgical armamentarium.

Standardization of the surgical approach from homogeneous results

Morbidity and especially pain after uniVATS surgery is intuitively reduced compared to open and three port VATS (7,8). However, a firm evidence is not found in the literature and this has been a major obstacle in disseminating the procedure in the midst of a ramping skepticism (10,12). While some flexibility in adapting the approach to the need to address the intrathoracic target lesion is necessary, the majority of the surgeons regularly performing uniVATS lobectomy seem to have elected the anterior approach popularized by Gonzalez-Rivas and coworkers as the most favorable one for this type of surgery (5,12). In the absence of a well-designed prospective, randomized study comparing open to three port VATS and three port to single port VATS, a conclusive evidence in the setting of which uniVATS approach could have been preferable might have resulted from an elegant study conducted by Casali and associates (13). Nevertheless, we might be facing the same scenario observed during the golden age of open thoracotomy—with the posterolateral thoracotomy being the preferred approach despite the increasing use of the lateral or antero-lateral incision (14-16). Another fundamental controversy evoked by the critics of uniVATS resides in the length of the incision; in fact, many argue that the single-port access is nothing but a mini-thoracotomy without rib-spreading. Apart from

the fact that the avoidance of rib spreading has been the most likely factor in determining the reduced morbidity and postoperative pain related to uniVATS (and of VATS, in general), the imperative for data analysis is under everybody's eyes. Also, the completeness and the attendant effectiveness of mediastinal nodal dissection has been questioned—the perplexity arises, as an example, from the feasibility of a thorough subcarinal dissection from an anterior approach (17,18).

An emerging approach among uniVATS surgeons is represented by the subxyphoid dissection which is meant to generate far less pain than the one caused by an intercostal incision (19-21). However, doubts as to the safe accessibility of all areas in the chest still remain.

Visualization and instrumentation

The mechanical disadvantage represented by the torsion angle created by three port VATS performed with 2D monitors has been already emphasized (22). Is modern technology helpful in making uniVATS more user-friendly for surgeons? Is the ergonomics of this approach consistent with an advantageous use of the single port approach? (23). There are few doubts that industry has supported the development of single port VATS lobectomy by manufacturing ad hoc instruments for this approach. However, it is obvious that we are nowhere near to what is needed to contribute to standardize the procedure. An interesting perspective is provided by the concept of microlobectomy which, in association with the uniVATS philosophy, could really represent a breakthrough for future generations of surgeons (24). In the meantime, a major question should be answered: should we prefer rigid or flexible/articulating instruments since the latter may better adapt to the inner geometry of the thoracic cavity and the pulmonary hilum. Needless to say, costs will be a crucial issue in the acquisition of ad hoc instrumentation (25); this is why it is important that new instruments are manufactured with careful observance of the inspiring philosophy behind the technique, the surgeon's needs and, hopefully, according to widespread, evidence-based acceptance for use of these instruments in the surgical armamentarium.

Robotics uniportal

An example of development of specific instrumentation

to comply with the surgeon's needs is provided by robotic surgery. Several versions of the primary robotic equipment have been proposed in the years with a progressive evolution towards single port robotic surgery. In addition, by general consensus, a major advantage of robotic thoracic surgery consists of the improved visualization compared to VATS due to the 3D monitors which allow for in-depth acquisition of the details of the surgical field. Laparoscopic single port robots are currently being made available in the clinical practice based on the technological refinement of an intracorporeal device deploying several arms to accomplish the same procedures possible before only with multiarm extracorporeally maneuvered robotic systems (26-28).

Awake or non-intubated uniportal VATS (uniVATS)

The attractiveness of such approach is immediately understandable since awake/non-intubated uniVATS represents the ideal procedure to facilitate fast tracking of patients with the reduced hospitalization costs (29-31). The possibility of introducing this approach into clinical practice has been demonstrated in several studies conducted in different clinical scenarios (29-31). The gap to be filled to facilitate more widespread implementation consists of a clearer definition of the indications and the anesthetic techniques to be used in order to convince the anesthesiologists of the viability and safety of a seemingly revolutionary procedure (29-31). With awake or non-intubated uniVATS, surgeons and anesthesiologists will have to work as a team like never before hence creating a sort of multidisciplinary group from the functionality of which much of the success of the approach will strictly depend (30,31).

NOTES and uniVATS

The feasibility of natural orifice uniVATS is under experimental consideration. The fundamental question investigators will have to answer is: "Cui protest?" i.e., who will benefit (from this procedure)? Animal studies have proved the feasibility of esophageal procedures, mediastinal exploration and lung biopsy and are generating proof of concept studies in humans (32-35). While diagnostic procedure may be envisaged to be performed through the esophageal route or, based on anatomic studies, through the floor of the oral cavity, therapeutic operations still appear, with the current technological possibilities, extremely challenging (36).

Hybrid OR and uniVATS

From a theoretical standpoint, uniVATS is an ideal thoracoscopic approach to contribute to procedures being carried out in hybrid OR's (37). In this setting, the placement of fiducials or markers via electromagnetic navigational bronchoscopy in close proximity of pulmonary nodules resectable by uniVATS represents a viable and substantial application of this new technology (38).

Conclusions

How far are we from a scenario when patient are consistently admitted early in the morning in an outpatient setting for a NOTES uniVATS minor diagnostic procedure or a uniVATS lobectomy under a non-intubated anesthetic management and dismissed the same evening with a remotely controlled drain system? (39). What are the implications of such scenario in terms of patient satisfaction and cost containment in our cost-conscious health systems? (40,41). Certainly, this seems a distant future especially since, as surgeons, we are still bound to conclusively demonstrate superiority of one approach on the other in the perspective of fast tracking patients through our hospitals (42,43). In a way, it is the same need that brought the pioneers of uniportal thoracic surgery to devise surgical strategies and instruments which could facilitate uniportal procedures (44,45). With the rapidly evolving technology of our times we have the unique opportunity and the responsibility to close the loop for the benefit of our patients and new generations of thoracic surgeons.

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Footnote

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