Non-intubated uniportal lung surgery†

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Received 2 September 2015; received in revised form 20 October 2015; accepted 27 October 2015

Summary

Uniportal video-assisted thoracoscopic surgery (uniVATS) is currently being used to diagnose and treat several intrathoracic conditions with minimal morbidity and reduced hospital stay compared with standard multiport VATS surgery. The potential advantages of uniVATS can be further enhanced by the adoption of loco-regional anaesthesiological techniques in non-intubated or awake patients yielding the possibility of performing an ever larger proportion of thoracic surgical procedures in an outpatient setting. This review will look at organizational and technical aspects of implementing a non-intubated uniVATS program.

Keywords: Awake surgery • Non-intubated • Thoracoscopy • Single port • Uniportal

INTRODUCTION

Uniportal video-assisted thoracoscopic surgery (uniVATS) reportedly leads to shorter hospital stay, less postoperative pain and paraesthesia both short and long term, and generates less hospitalization costs compared with three-port VATS [1, 2]. These advantages make uniVATS a suitable approach to fast-track patients through diagnostic and therapeutic pathways [1–3]. In addition, the ability to perform uniVATS in the non-intubated or the awake patient potentially facilitates the use of this approach in an outpatient setting, especially if a no drain policy is associated with uniVATS [3]. Rocco et al. reported on a series of procedures that can be done in non-intubated or awake patients [4, 5]. In fact, biopsy of parietal pleura, pleural abrasion or pleurectomy along with the resection of blebs or bullae and pulmonary biopsy for interstitial lung disease are indications amenable to outpatient management or fast-tracking [1, 4, 5]. In addition, mediastinal nodal biopsy or removal, thoracic sympathectomy and pericardial windows may represent suitable mediastinal indications for awake uniVATS [3]. Additional reasons to perform non-intubated uniVATS could be trauma in the haemodynamically stable patient and to favour dissection of major intrathoracic components of sizeable tumours [3].

On the basis of experience on diagnostic and minor therapeutic procedures, several pioneers of uniVATS have championed the concept of awake or non-intubated uniVATS for major pulmonary resections [6–10]. As an example, Gonzalez-Rivas et al. were able to prove the feasibility and safety of this approach for pulmonary lobectomy for selected indications and with the support by an enthusiastic and competent anaesthesiological team [11]. This technique is also being increasingly used in Asia [9, 12] where, along with the potential clinical advantages of this technique, the respect of the corporeal integrity expressed in the Chi philosophy makes non-intubated uniVATS an ideal approach from a socio-cultural standpoint [13].

TECHNICAL ASPECTS OF NON-INTUBATED OR AWAKE UNIPORTAL VATS

Absolute contraindications to non-intubated or awake uniportal VATS

Since the anaesthesiological gold standard for uniVATS is general anaesthesia, awake or non-intubated uniVATS is an approach to be selected by rigorous exclusion of its contraindications [7].

In a soon-to-be published contribution, Gonzalez-Rivas et al. have clearly defined the contraindications of this approach which should be kept in mind when selecting—and consenting—potential candidates [7]. Three categories of ineligibility for awake or non-intubated uniVATS have been identified, namely, patient-related (i.e. obesity, neurological conditions, uncontrolled gastroesophageal regurgitation, central hypoventilation syndrome, persistent cough or mucus retention, haemodynamically unstable or severely hypoxia/hypercapnia), anaesthesiologist-related (i.e. difficult intubation, technical contraindications to general anaesthesia, need to protect the contralateral lung from spillage of endobronchial contents and inexperienced or non-cooperative team) and finally surgeon-related (i.e. uniVATS experience, previous operations with adhesions) [7]. Since solid and definitive data on the outcomes of awake uniVATS are not available, eligible patients should be consented by explaining the reasons to opt for loco-regional in lieu of general anaesthesia [7]. This is particularly important when the uniVATS surgeon is asked to mentor outside his/her own institution during meetings focused on live surgery.

†Presented at the 3rd Asian Single Port VATS Symposium & Live Surgery, The Chinese University of Hong Kong, Hong Kong, China, 26–27 March 2015.
Non-intubated with deep sedation

If the above contraindications are excluded, major intrathoracic procedures may still require some degree of airway control and enough sedation to control the cough reflex without depressing the respiratory mechanics. Gonzalez-Rivas et al. routinely use facial mask or nasal cannulae and tend to replace facial masks with laryngeal masks as well-tolerated devices to secure ventilation and to avoid the risks related to intubation. Loco-regional anaesthesia is obtained through a combination of epidural analgesia and paravertebral or intercostal nerve blockade. The suppression of the cough reflex is achieved by injecting the vagus with local anaesthetics or by administering aerosolized lidocaine. For major procedures, the epidural catheter can be positioned at T3–T4 level and remifentanil can be used to maintain deep sedation.

Loco-regional anaesthesia in the awake patient

This approach is consistently used for minor diagnostic and therapeutic uniVATS procedures. In fact, undetermined pleural effusions can be routinely diagnosed without the need for general anaesthesia. For these procedures, vagus and phrenic nerve blockade is rarely—if not ever—necessary but the use of epidural analgesia is contemplated by placing the catheter at slightly lower level, i.e. T5–T6. Rocco et al. described in detail their criteria to manage loco-regional anaesthesia during uniVATS. As a rule, a single shot of 1% ropivacaine solution (10 mg/ml diluted to 5 mg/ml for a total dose of 15 ml = 75 mg) was injected. The patient was also given intravenous midazolam (4 mg), fentanyl (100 µg) and propofol (0.5 mg/kg/h up to a total of 30 mg in 1 h) along with supplemental oxygen by nasal prongs to keep arterial oxygen saturation above 90%. This protocol should guarantee a pain-free surgical field for at least 3 h. Moreover, to simulate the complete atelectasis achieved with one lung ventilation, a 1.8-mm Fogarty balloon is inserted under bronchoscopic guidance to occlude the tributary bronchus. In addition, the skin site is injected with bupivacaine to enhance pain control. Hung et al. recently made a useful contribution to the perioperative management protocol during uniVATS awake resection of peripheral nodules by applying a BIS (bispectral index) Quatro sensor (Aspect Medical System, Norwood, MA, USA) to the forehead of each patient to monitor the level of consciousness and thus gauging the level of deep sedation required for the procedure. Interestingly, these authors routinely added intrathoracic vagal blockade to ensure cough control. In addition, Gonzales-Rivas et al. have introduced a new protocol into clinical practice to perform totally awake major thoracic surgery, using epidural anaesthesia (level T3–T4, sensitive blockade T2–T10) in combination with vagus and phrenic nerve blockades under ultrasound control at the neck.

Troubleshooting

Clear contraindications and clear indications to conversion to general anaesthesia similarly become crucial to the safety and the reproducibility of uniVATS awake or non-intubated. Preparation for conversion is adequately predisposed before the incision, anticipating bronchoscopic guidance for intubation as well as the rapid insertion of a chest drain through the singe incision. For an experienced anaesthesiologist, intubation of patient in the lateral decubitus should not represent an insurmountable difficulty, especially when, prior to surgery, the patient was given a Mallampati score of 1 and demonstrated an acceptable neck extension with a thyromental space extending for more than four finger breadths. However, the decision to conversion should be made jointly by the attending surgeon and the anaesthesiologist. In this setting, conversion should not be delayed when a steady intraoperative field cannot be obtained (i.e. due to cough or increasing oscillations of respiratory movements), and in the event of diffuse and tenacious pleural adhesions, persistent hypoxemia (oxygen saturation on pulse oximetry of <80%), unstable haemodynamic status or uncontrolled bleeding requiring an emergency thoracotomy. Metcullous adherence to this protocol allows for minimization of the conversion rate to 4%.

PATIENT POPULATION AND LOGISTIC ASPECTS NON-INTUBATED OR AWAKE UNIPORTAL VATS

Whom should we offer awake or non-intubated uniVATS procedures to? Given the rigid exclusion criteria, the unpredictable intraoperative course and taking into consideration the lack of data on outcomes of these procedures, a careful selection of patients is mandatory. Several investigators have proposed to use uniVATS awake or non-intubated in geriatric patients or in patients at high risk for postoperative morbidity/mortality for thoracotomy. On the other hand, these individuals might as well be categorized into one of the contraindication groups and deemed not suitable for awake or non-intubated VATS. Nowadays, it appears clear that availability of local expertise and resources along with sound clinical judgement will equally contribute to the decision-making process for awake or non-intubated VATS.

In addition, in a time when stereotactic body radiation therapy is being consistently advocated as a viable alternative to surgery for lung cancer, strong evidence supporting these procedures is needed in the near future to provide surgeons with another reliable management pathway (i.e. non-intubated or awake procedures). From an oncological standpoint, many unresolved issues need to be tackled—i.e. the opportunity for radical lymphadenectomy versus nodal sampling in patients subjected to major pulmonary resections by non-intubated uniVATS. In fact, the inevitable dissection around main stem or lobar bronchi could elicit uncontrollable coughing, thus rendering the procedure more difficult if not hazardous. In this setting, either epidural analgesia or vagal blockade needs to be instituted in order not to compromise the oncological efficacy of the operation. In conclusion, thoracic surgeons should perform a careful review of the institutional case-mix to select the most suitable patients for awake or non-intubated uniVATS in order to develop, along with the anaesthesiologists, the necessary experience and expertise needed to establish an awake or non-intubated uniVATS programme. In turn, an institutional registry should be created and linked to national and international ones to produce reliable outcome data. Another issue to be considered when establishing a uniVATS programme is the operative resource allocation. Especially in the steepest segment of the learning curve, uniVATS lung resections may take longer and may require dedicated personnel and instrumentation.

Moreover, depending on the risk profile of the surgical candidates, dedicated intensive care or step-down beds should be contemplated for uniVATS patients undergoing awake or non-intubated procedures. In this setting, the choice of dedicated operative lists run by dedicated surgeons within the team (i.e. uniVATS lobectomists) should be supported by the administrators and staffed by the
anaesthesiologists in order to avoid delays and cancellation of cases scheduled in the regular operative lists. Furthermore, since awake or non-intubated uniVATS represents a potentially less morbid approach to the same thoracic procedures routinely performed via open thoracotomy of conventional VATS, the postoperative costs will be abated only if a statistically significant reduction if the length of hospital stay will be demonstrated in the future.

ACTUAL VOLUMES AND IMPEDMENTS TO CLINICAL DISSEMINATION OF AWAKE OR NON-INTUBATED UNIPORTAL VATS

A recent survey issued by the European Society of Thoracic Surgeons (ESTS) on non-intubated thoracic surgery (NITS) provides some interesting clues as to the potential hurdles preventing a widespread dissemination of awake or non-intubated uniVATS [24]. In fact, out of more than 1300 ESTS members, only 105 responded (8%); of these, 40% claimed to have been involved in NITS before or up to year 2000 and almost 70% did not perform more than 5 procedures [24]. In terms of the anaesthetic modalities associated with NITS, intercostal blocks, thoracic epidural and laryngeal masks were predominantly used on patients who could actively interact with the surgeons in 70% of the cases [24]. While the majority of procedures were minor diagnostic or therapeutic ones, anatomical pulmonary resections (i.e. segmentectomy, lobectomy and pneumonectomy) were performed with NITS in only 8% of the patients [24]. Among the respondents to the survey, high-risk patients (i.e. elderly or with poor cardiopulmonary function/multiple comorbidities) were felt to be suitable candidates for NITS [24]. Expectedly, improved perioperative indices (i.e. quicker recovery, reduced morbidity, length of stay and costs) were considered major advantages associated with NITS, albeit the possibility of patients accepting more liberally NITS than conventional procedures was contemplated by only one-third of the respondents [24]. As to the perceived hazards hampering the NITS procedures, uncontrolled cough, wide diaphragmatic excursion and lung or patient’s movements were most frequently reported [24]. Only 13% of the respondents felt that no disadvantages were associated with NITS [24]. Interestingly, the importance of the anaesthesiological team and of other logistic factors was somehow neglected. This is the major difference with uniVATS given the peculiar approach and the attendant technical challenges for the entire operating staff.

CONCLUSIONS

Awake and non-intubated uniVATS procedures will become a considerable part of the thoracic surgical armamentarium due to the appealing feature represented by the avoidance of general anaesthesia. The success of this multidisciplinary programme is bound to be linked to the fruitfulness of the collaboration with dedicated anaesthesiologists who, along with the patients and surgeons themselves, will have to be convinced of the feasibility, safety and cost-effectiveness of this innovative approach by the strength of outcome data derived from large numbers of registries.

Conflict of interest: none declared.

REFERENCES