Cervical incision thoracic endoscopic surgery: a minimally invasive endoscopic approach in thoracic surgery

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Abstract

Cervical incision thoracic surgery has recently been described. Currently, there is a move to increase the role of flexible endoscopy in surgery. The use of a flexible endoscope through a natural orifice into the thoracic cavity still remains ethically doubtful. The authors present a surgical experimental study using a flexible endoscope through a cervical incision for the exploration of both the mediastinum and the thoracic cavity in a cadaver. An experimental work on 10 refrigerated and non-embalmed cadavers was initiated. We used a unique device – a standard double-channel flexible video gastroscope. Through a small cervical incision, we performed simultaneous exploration of the mediastinum and both pleural cavities. Identification and biopsies of mediastinal lymph nodes at levels 2R, 4R, 7 and 4L were easy to perform in all subjects. In eight cadavers, we performed an assessment of bilateral pleural cavities and multiple pleural biopsies as well as bilateral thoracic sympathectomy. A chest tube was placed in the thoracic cavity at the end of all pleural procedures. The potential advantages of this approach are simultaneous exploration of the mediastinum and pleura and the performance of several thoracic interventions through a single cervical incision. The flexible endoscope could become a surgical tool for thoracic surgery.

Keywords: Thoracoscopy; Mediastinoscopy; Endoscopic procedures; Minimally invasive surgery

1. Introduction

Lung cancer is the most common indicator for thoracic surgery. Cancer staging is an inescapable step before cancer treatment. Mediastinal lymph nodes and pleural biopsies are frequently needed for staging this cancer. This multidisciplinary team work includes the thoracic surgeon, the pneumologist and the endoscopist [1].

Despite the development of less invasive techniques for mediastinal exploration, such as trans-bronchial needle aspiration (TBNA), endoscopic ultrasound-guided fine-needle aspiration (EUS-FNA), and more recently, endobronchial ultrasound-guided fine-needle aspiration (EBUS-FNA), mediastinoscopy and video-thoracoscopy still remain the more satisfactory and commonly performed invasive techniques for mediastinal and pleural staging in patients with lung cancer [1, 2]. In some cases both mediastinal and pleural explorations are needed and require two separate interventions for the same patient.

The development of thorascopic approaches during the early 1990s excited thoracic surgeons because of the multiple advantages of this technique [3]. Unfortunately thoracoscopy did not significantly affect postoperative pain, while it did unquestionably decrease length of hospital stay and cost, rate of scar complications, and had added cosmetic advantages. The need for thoracic ports and chest tubes are a major cause of persistent pain [4].

Minimally invasive techniques in thoracic surgery are evolving. Several procedures have recently described thoracic surgical interventions which were performed through a cervical incision in humans [5–7]. There is a trend in favour of using flexible endoscopy in general surgery [8]. Flexible endoscope is used in Natural Orifice Trans-luminal Endoscopic Surgery (NOTES) techniques [9, 10]. Few cases in the literature reported its application in abdominal surgery [11]. No in-human application has yet been described for NOTES in thoracic surgery. Ethical limits and the risk of major mediastinal complications limit its application in humans.

The aim of this experimental work on human cadavers is to present the use of flexible endoscope for simultaneous exploration of the mediastinum and pleura through a single cervical incision.

2. Materials and methods

The experimental protocol of this study was approved by the Committee of Human Subject Research and Body Donation of The University Paris V ‘Rene Descartes’. It was carried out at the Department of Anatomy. The procedure was carried out 10 days after death on 10 refrigerated and non-embalmed cadavers. The subjects were free from chest and neck disease.
The mean age on death was 90.3 years (88–93 years). Subjects were placed in dorsal decubitus with neck hyper-extension. We used a standard double-channel flexible video gastroscope (STORZ®), a Karl Storz Cold Light Fontaine Xenon 100W, a TELE PACK™ endoscopic video and a 15" Flat Screen Monitor. The first step was similar to a conventional cervical video-assisted mediastinoscopy. A 1 cm horizontal incision was made just above the sternal manubrium. All tissues in the pre-tracheal fascia were dissected. Digital dissection was then performed following the upper and lateral sides of the trachea. The video gastroscope was then introduced through the cervical incision and a total mediastinal exploration was performed.

The second step was the creation of mediastinal pleural windows. On the right side, a digital dissection of the right mediastinal pleura under the level of the superior vena cava was performed, creating a communication between the mediastinum and the right pleural cavity (Fig. 1). On the left side, the pleurotomy was also digitally performed between the left common carotid and subclavian artery. The video gastroscope was then introduced into the pleural cavities through both pleurotomies.

3. Results

The mediastinal exploration allowed an excellent visualisation of the mediastinal structures in all cadavers. Mediastinal lymph nodes: 2R, 4R, 7 and 4L were consistently identified and biopsies were easy to perform (Fig. 2). The introduction of the video gastroscope into the pleural cavities through the previously created mediastinal windows was not difficult in eight subjects and allowed a wide exploration of both pleural cavities.

In the remaining two cadavers, the introduction of the scope into pleural cavity failed due to dense adhesions in the pleural space. In the eight cadavers, we performed bilateral multi-site pleural biopsies using a grasp forceps (Fig. 3). Finally, we performed a bilateral partial thoracic sympathectomy using both grasp forceps and electro-coagulation. We dissected the pleura apropos the sympathetic nerve using electro-coagulation, the forceps grasped the nerve and the resection was performed using an electro-coagulation needle (Fig. 4). At the end of the procedure, a 20 French silicone chest tube was placed through both the cervical incision and the pleural window. The intrathoracic position of the tube was visually verified (Fig. 5). The tube was exteriorised from the cervical incision (Fig. 6).

4. Discussion

The thoracoscopic approaches developed in the early 1990s disappointed thoracic surgeons. The persistence of postoperative pain remained unresolved. The need of thoracic ports and chest tube are the major cause of this pain [4]. Minimally invasive techniques in thoracic surgery are currently evolving. Thoracic procedures using classical
instruments through a cervical incision have recently been described [5–7]. The rigidity of the instruments used in these procedures does not allow for extensive exploration of the pleural cavity [6, 7]. There is a move to increase the role of flexible endoscopy in surgery [8]. The use of a flexible endoscope through a natural orifice (NOTES) into the thoracic cavity still remains ethically doubtful in humans as does the trans-oesophageal approach in trans-gastric or vaginal applications [12, 13].

Swantstrom et al. recently published a report on the use of flexible endoscope into the mediastinum through a cervical incision for Heller myotomy and oesophagectomy in six animals and one cadaver [8]. Our described approach in cervical incision thoracic endoscopic surgery (CITES), using a flexible endoscope though a validated cervical incision, adds to the access and exploration of the pleural cavities. CITES can be adapted for thoracic specificities (e.g. chest tube placement) and could avoid major mediastinal complications in comparison with NOTES. The extreme flexibility of the endoscope offers the possibility of a complete pleural inspection and could be used for biopsies in several thoracic sites and the performance of more complicated surgical procedures (e.g. sympathectomy).

The access to the left hemi-thorax through the mediastinum remains challenging. Few cases in the literature [14, 15] demonstrated that the aortic arch makes the advancement of the video-mediastinoscope into the left hemi-thorax difficult and dangerous. Chamberlain et al. [7] recently reported the same findings. Fowkes et al. [6] described bilateral pleural procedures through a cervical incision in 15 patients (six on left side, eight on right side and one bilateral). However, they showed the limits of rigid instruments for aorto-pulmonary window access. In addition, two of their patients developed left recurrent laryngeal nerve palsies which represent a real limitation of this technique on the left side. Flexible endoscope used in CITES could be more secure in left side approaches.

In conclusion, the use of flexible endoscopy in surgery is facilitated by the introduction of novel instrumentation designed for NOTES. We are currently conducting experimental work on animals (sheep) to confirm firstly the feasibility of this technique on living animals and secondly, to develop new applications of the CITES approach in thoracic surgery. The flexible endoscope could become a surgical tool for thoracic surgery.

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References


