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Video-assisted thoracic surgery versus pleural drainage in the management of the first episode of primary spontaneous pneumothorax

Duilio Divisi, Ph.D., M.D.*, Gabriella Di Leonardo, M.D., Roberto Crisci, M.D., Ph.D.

Department of Thoracic Surgery, University of L'Aquila, "G. Mazzini" Hospital, Piazza Italia 1, Teramo, Italy

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Abstract

BACKGROUND: The aim of the study was to analyze the cost-effectiveness outcomes of video-assisted thoracic surgery (VATS) in the treatment of primary spontaneous pneumothorax (PSP), comparing the minimally invasive procedure with pleural drainage (PD).

METHODS: Between July 2006 and October 2012, we treated 122 patients with a first episode of PSP by VATS (61 patients) or pleural drainage (61 patients). We established the relationship between costs and quality-adjusted life (QAL) for both techniques.

RESULTS: The total cost per patient of minimally invasive procedure was more advantageous than that of chest tube (€2,422.96 vs €4,855.12). The QAL expectancy of VATS was longer than that of PD (57.00 vs 40.80 at 60 months). The QAL year of VATS (.32 at 1st year and .25 at 5th year) was better than that of PD. Incremental cost-effectiveness ratio of VATS versus PD was between €7,600.00 (1st year) and €10,045.00 (5th year), remaining well below the threshold of acceptability.

CONCLUSION: VATS as the first-line treatment for PSP allowed low morbidity, short hospitalization, and excellent quality of life.

The management of primary spontaneous pneumothorax (PSP) is still debated. Pleural drainage, video-assisted thoracic surgery (VATS), and axillary minithoracotomy represent the therapeutic options that should be evaluated in terms of cost effectiveness, considering the cuts to the health budget. VATS was judged the gold standard approach in recurrent spontaneous pneumothorax. Crisci et al[1] showed, in a retrospective study of 60 patients, that VATS compared with traditional thoracotomy allowed a cost savings of 23%. However, VATS appeared to be justified even at the first spontaneous pneumothorax compared with pleural drainage (PD),[2] ensuring a reduction in hospitalization (6 vs 12 days), recurrences (1 vs 8 patients, equivalent to 2.8% vs 22.8%), and costs (33%). The purpose of the study was to clarify the role of VATS in PSP, assessing the indications based on quality-adjusted life (QAL) and costs to avoid relapses.

Patients and Methods

From July 2006 to October 2012, we observed 122 patients with a first episode of PSP. Symptoms responsible for arrival at the emergency room were sudden chest pain

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* Corresponding author. Tel.: +39-0861-42-94-82; fax: +39-0861-42-94-78.

E-mail address: duilio.divisi@aslteramo.it

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associated with difficulty in breathing. No patient displayed acute respiratory insufficiency requiring aspiration or PD. Chest X-ray and thin-section computerized tomography of the thorax allowed diagnosis, characterized by no evidence of lung disease. Large pneumothorax (distance between the lung margin and the chest wall superior to 2 cm) was found in 96% of the patients. There were 79 men (65%) and 43 women (35%), with an average age of 23 ± 2 years ranging from 16 to 30 years. After ethics committee approval, we proposed in primary intention the minimally invasive approach or PD to resolve pneumothorax. Sixty-one patients were treated with VATS and 61 with PD in the ratio of 1 to 1, within 35 ± 3 minutes of arrival at the hospital. A written informed consent from each patient was obtained before each procedure. The VATS and thoracostomy tube male/female ratio was 4: 1 and 3: 1, respectively.

Surgical procedures

Thoracostomy tube (Redax S.r.l., Mirandola, Italy) sized 28 French was placed under local anesthesia (2% Mepivacaine) in the 5th or 4th intercostal spaces on the mid-axillary line and connected to continuous suction of 25 cm H_2O.

VATS was performed under general anesthesia and selected bronchial intubation. Three port thoracoscopic accesses were made in the 6th, 5th, and 4th or 3rd intercostal spaces for insertion of a video camera (through an 8-mm thoracoport on the mid-axillary line), stapler (through an 11.5-mm thoracoport on the anterior axillary line), and Endo Dissect (through a 5-mm thoracoport on the posterior axillary line). Visceral blebs and bullae were resected using the Endo GIA 30 (Autosuture; United States Surgical Corporation, North Haven, CT) or Echelon 60 Flexible (Ethicon Endo-Surgery; Johnson & Johnson Medical SpA, Pomezia, Rome, Italy). If no lesion was highlighted, an apical wedge resection of the upper lobe was carried out. The electro-pleurodesis on the 3rd, 4th, and 5th ribs was performed in all patients. Two silicone chest tubes sized 28 French were inserted through the incision on the 5th and 6th intercostal spaces and connected to continuous suction of −20 cm H_2O. The incision on the 4th or 3rd intercostal space was closed by 2 separate stitches with nonabsorbable polyfilament 3-0.

Costs

We analyzed operating room charges (operating room time, anesthesia fees, filaments of suture, double-lumen tube, chest tube, hardware). The surgical factors evaluated were divided into operative (time of intervention), postoperative (prolonged air leaks (PAL) beyond 6 days, duration of PD, length of hospitalization) and long-term morbidity with a follow-up at 60 ± 3 months (recurrences and subsequent management). The cost of employment of the operating room was €167.00 per hour (equivalent to €2.8 per minute) inclusive of surgeon's and anesthesiologist's fees, while that of a single day of hospitalization was €350.00. Costs of camera, monitor, thoracoscope, and light source were not taken into account because totally paid for by VATS carried out until to 2005. Costs of relapses and PAL were spread out over all patients according to the "Intention to treat" analysis.[3] It is a statistical analysis based on the initial intent of the procedure preserving the effects of comparability randomization and measuring its effectiveness on patients.

Quality-adjusted life

Effectiveness evaluation for each technique was carried out based on the adjustment of quality of life expectancy (QALE) and quality of life year (QALY). QALE and QALY allow to assess the value of interventions in health and medicine. The QAL was established through the EuroQol questionnaire[4–6] administered to all patients at the 1st, 2nd, 3rd, 4th, and 5th years after treatment. The utilities (EQ-5D with US scoring) of health status taken into consideration were the following: (1) ability to move (*m*); (2) care for themselves (*s*); (3) usual activity (*a*); (4) pain/discomfort (*p*); (e) anxiety/depression (*d*). Three levels of severity were evaluated through specific scores for single dimension: (1) none; (2) moderate; and (3) severe. The synthetic value of quality of life at the time of the interview (time trade-off method) was obtained by the following algorithm: $1 - c - m - s - a - p - d -$ n3. The index ranged from 1 (perfect health) to 0 (death of the patient). Changes in patient health were calculated by subtracting the maximum value, that is 1, from the values of points *m*, *s*, *a*, *p*, and *d* corresponding to the dimensions of health status derived from the questionnaire. The coefficients *c* (.081) and n3 (.269) were subtracted if any dysfunction was noticed and if any dimension had level 3, respectively. The QALE was obtained multiplying the value of utilities (established by the time trade-off method) at the time of first interview by the follow-up (up to 5 years). The EQ-5D values, adjusted to the overall mean baseline health status per year, provided the QALY for VATS and PD. This makes it possible to determine the incremental cost per life year gained, weighted per QALY (incremental cost-effectiveness ratio). We calculated the costs of both procedures at baseline and assessed the follow-up for 5 years. The expected costs and health status for 5 years were analyzed with 2-way sensitivity analyses, using an inflation rate of .8% as discounting rate per year. Based on the guidelines of the Italian Association of Health Economics, we decided to adopt a threshold of acceptability inferior to €15,000.00 per year of life saved. Any value above this value was deemed unacceptable.

Statistical analysis

Analysis was performed using SPSS 10.0. Data were entered in a database using SPSS Data Entry II (SPSS, Inc,