Case report

New operative method for a giant bulla: sutureless and stapleless thoracoscopic surgery using the Ligasure system

Norihisa Shigemura*, Akinori Akashi, Tomoyuki Nakagiri

Division of the General Thoracic Surgery, Takarazuka Municipal Hospital, 4-5-1 Kohama, Takarazuka-shi, Hyogo 665-0827, Japan

Received 26 March 2002; received in revised form 1 July 2002; accepted 3 July 2002

Abstract

Thoracoscopic bullectomy performed with staplers is the main treatment for giant bullae in many institutions. However, there are certain problems associated with the increasing use of stapling devices. In response, we have applied a new operative method in which we excised a bulla with an ultrasonic-driven scalpel and successfully sealed the cut ends using the LigaSure Vessel Sealing System, a new bipolar system developed by Valleylab Inc. Herein we describe our experience with this newly designed technique which could render possible ‘sutureless and stapleless’ thoracoscopic surgery in the future. © 2002 Elsevier Science B.V. All rights reserved.

Keywords: Giant bulla; Thoracoscopic surgery; LigaSure; Sutureless and stapleless surgery

1. Introduction

For respiratory operations, thoracoscopic surgery has been used increasingly as a first choice, even for diseases which were previously considered difficult to treat with such means, due to recent developments in surgical apparatus and technique.

A giant bulla is one of the conditions for which partial excision under thoracoscopic guidance with subsequent use of a stapler for prevention of postoperative pulmonary fistula, is selected by many institutions [1]. However, in the case of multiple lung cysts, some problems have occurred as the frequency of stapler use has increased [2]. In the present case, we excised a giant bulla with an ultrasonic-driven scalpel and successfully sealed the cut end using the LigaSure Vessel Sealing System (LVSS) (Auto Suture, Valleylab: Boulder, Colorado), a new bi-polar system developed by Valleylab Inc., instead of using stapling devices. Herein we describe our experience with this newly designed technique as well as the possible histological effects of LVSS.

2. Case report

The patient was a 39-year-old man with bilateral emphysematous cysts discovered in previous radiographic examinations of the thorax. Later, he developed pneumothorax on the left side that improved with conservative treatment. However, exercise-induced dyspnea gradually increased, which brought him to our department. A radiographic examination revealed bilateral avascular upper lung fields. Respiratory functional tests revealed dysfunction of moderate degree: VC 2.44 l (67%), FEV1.0 2.03 l (55%), RV 2.10 l (138%), and TLC 5.73 l (103%). He was diagnosed with a giant bulla requiring surgical treatment.

3. Technique and results

The patient was situated normally and the trocar was inserted as usual. We began the procedure with the patient in the left lateral recumbent position. A 10-mm port was created at the sixth intercostal space along the posterior axillary line, through which the thoracoscope was inserted. Next, 5-mm ports were created at the eighth intercostal space along the posterior axillary line, fourth intercostal space along the anterior axillary line, and sixth intercostal space beneath the scapula.

First, the giant bulla in the upper lobe was severed using an ultrasonic-driven scalpel (Ethicon Endo-Surgery, Johnson and Johnson Medical, Cincinnati, OH), and the margin to normal lung tissue was identified. After resecting the bulla (Fig. 1A), the cut surface was approximated and clamped by forceps, and then sealed using the LVSS. Sealing was repeated at 1-cm intervals in the same manner as a skin stapler (Fig. 1B). After confirming hemostasis, a water-
A seal test was performed with a pressure of 20 cmH\textsubscript{2}O to confirm the absence of leakage. The incision was closed to complete the surgery.

The operating time was 75 min and there was very little bleeding. Thoracic drainage continued for 3 days and the patient was discharged safely after 1 week as the recovery course was uneventful. Twelve months postoperatively no recurrence of bulla, residual space or pneumothorax were found. Furthermore, respiratory function 6 months postoperatively showed favorable results: VC 3.06 l (84%), FEV\textsubscript{1.0} 2.89 l (89%), RV 1.54 l (98%), and TLC 4.70 l (83%).

Fig. 1C shows a pathohistological image of the suture in the extirpated human lung sealed by using LVSS. The specimen was involved in the lobe of another old, operated patient who had lung cancer and a giant bulla in the same lobe. He had required lobectomy in his operation, and after the extirpation of the lobe, the bulla was resected and sealed by using an ultrasonic-driven scalpel and LVSS with his consent beforehand. The image of the sealed part, which was taken and observed 7 days after the operation, confirmed that the part was securely fused with minimum tissue degeneration.

4. Discussion

Thoracoscopic surgery for giant bullae is an accepted procedure worldwide. However, since frequent use of a stapler is required, economic problems and postoperative respiratory hypofunction due to an increase in the volume

---

Fig. 1. (A,B) Operative view under thoracoscopy. (A) The cut surface after bullectomy is presented. (B) Both margins are approximated, clamped and sealed using LVSS. (C) Pathohistological image of sealed lung 7 days after the operation.

Fig. 2. Schema of the new operative method using LVSS for a giant bulla. (A) The bulla is severed with precision using an ultrasonic-driven scalpel, while preserving the margin to normal parenchyma. (B) After complete excision of the bulla, the cut surface is approximated and clamped by forceps. (C) Sealing the cut surface with LVSS is repeated at 1-cm intervals to completion.
of the normal lung near the bulla resected are cause for concern. Furthermore, it has been noted that complete excision of a cyst close to the hilum pulmonis may occasionally be difficult, as a stapler with a large major axis creates a large port hole and limits the insertion angle thus causing technical difficulty [2,3]. Moreover, suturing under thorascopic conditions requires considerable technical skill and air leakage from needle holes at the cut end of the lung may cause various complications in severe emphysematous lung.

To overcome these problems, we employed an ultrasonic-driven scalpel for excising the bulla and the LVSS for suturing the lung after excision (Fig. 2). We found that the ultrasonic-driven scalpel had good handling and enabled precise resection, resulting in less damage to the tissue as compared to an electric scalpel. By employing this instrument a precise cut along the margin between pathological and unaffected lung tissue was obtained, and only a minimal amount of normal lung was excised with minimal coagulation and optimal hemostasis. When cutting the tissue, bleeding and pulmonary fistula could be controlled with minimal tissue damage. There are a few other reports regarding this tool for thoracoscopic surgery [4], and its use is expected to increase in the future.

LVSS, a new bipolar system for vascular sealing that is increasingly being utilized in the field of general surgery, has been noted before for its sealing reliability [5]. LVSS uses a higher power current at a lower voltage as compared to conventional electric scalpels, thus enabling it to resolve and unite collagen in the tissue and surrounding connective tissue for prompt sealing. Further, the LVSS generator itself is equipped with a function that determines the kind of tissue clamped and automatically adjusts the output to one most appropriate for sealing the tissue effectively, after which it automatically stops when sealing is completed. This prevents the device from exerting excessive energy and minimizes the effect on surrounding tissue [6]. Its use has already been authorized by the US Food and Drugs Administration for all general surgery and urological operations as well as most gynecological procedures [6–8]. However, the use of LVSS in the field of respiratory surgery has not yet been reported. The forceps used in LVSS can be inserted through a port hole 5 mm in diameter, allowing excellent handling.

The pathohistological image, shown in Fig. 1C, confirmed that the sealed part was securely fused with minimum tissue degeneration. Heat transmission to the surrounding tissue by LVSS ranges from 1 to 1.5 mm and is said to be inhibited in the same manner as that of an ultrasonic-driven scalpel [5], and we confirmed the histological effects of LVSS in the lung.

The present operation required 75 min, with a negligible amount of bleeding (levels too low for measurement). Drainage lasted for 3 days, very similar to cases sutured using a stapler. The operating time and amount of bleeding in our case were less than others reported [1,2].

Pulmonary tissue sealing strength with LVSS has not been confirmed experimentally. Accordingly, we currently consider that patients similar to the present, having a bulla with a relatively thin stem, or others in whom high intra-alveolar pressure is less likely to build up at the point of suture, are best suited for the procedure. Additionally, besides the peripheral lung parenchyma, we consider that LVSS might be able to be applied to the tissue involving thin vessels such as Botallo’s ligament, or the interlobular-plasty after lobectomy. Although we used LVSS together with an ultrasonic-driven scalpel in the present case, these two instruments are considered to be useful if utilized solely in the field of respiratory surgery. However, in order to confirm effectiveness of LVSS and its indication for broad-based bullae and cysts, and others, further clinical experience will have to be accumulated in the future.

Ligatures, suturing, and hemostasis are more time-consuming in endoscopic surgery as compared to conventional surgery. For suturing of lung parenchyma only needle and thread or staplers are currently in use; however, LVSS might be able to overcome some operative, economic, and technical problems inherent in conventional techniques in certain cases. Although short-term and long-term results are still not available in sufficient number and quality, we firmly believe that a surgical method based on the advantages provided by LVSS will meet the needs of present-day surgery and may be a step forward to true ‘sutureless and stapleless’ surgery.

References