



TECHNICAL NOTE

Technique for tailoring complex demarcation in lung segmentectomy

Jun Wang* , XinFeng Xu*, Wei Wen, WeiBing Wu, Quan Zhu & Liang Chen 

Department of Thoracic Surgery, The First Affiliated Hospital of Nanjing Medical University, Nanjing, China

Keywords

Intersegmental demarcation; lung cancer; segmentectomy; surgery.

Correspondence

Liang Chen, Department of Thoracic Surgery, The First Affiliated Hospital of Nanjing Medical University, #300 Guangzhou Road, Nanjing, 210029, China.

Tel: +86 25 6830 3761

Fax: +86 25 6830 3760

Email: njmuclbriht@163.com

*Jun Wang and XinFeng Xu contributed equally to this work.

Received: 6 July 2018;

Accepted: 12 August 2018.

doi: 10.1111/1759-7714.12864

Thoracic Cancer 9 (2018) 1562–1564

Introduction

Despite the widespread application of segmentectomy for early-stage lung cancer,¹ intersegmental demarcation dissection remains a difficult procedure, thus the techniques used to perform an accurate segmentectomy are currently a hot topic of discussion. Previous reports have mainly focused on a comparison of results between energy devices and staplers.² However, details for tailoring the intersegmental demarcation and the anatomical theoretical basis of application have not been reported. Many thoracic surgeons empirically dissect the intersegmental demarcation and select the energy device or stapler randomly. According to the location of the segment and the anatomical features of lung segment intergradation,³ the intersegmental borders can be divided into simple and complex types. Obviously, for a deeply located segment with two or more curved intersegmental borders, a dimensional tailoring method rather than a linear tailoring method has practical significance.

Abstract

Segmentectomy is a widely adopted surgical procedure, however, experiences of tailoring the intersegmental border have rarely been reported. This paper investigates the strategy and results of tailoring complex demarcation during lung segmentectomy surgery. Because intersegmental demarcation can be divided into plane or curved types according to the location and stereo shape of a segment, a one-size-fits-all method for tailoring the intersegmental demarcation is obviously unreasonable. For tailoring a complex segmentectomy with two or more curved borders, tips including good exposure of the intersegmental demarcation, sharp-blunt combined dissection skill, “work-plane” extension, and “gate” opening techniques all contribute to an accurate segmentectomy. This technique, based on anatomical characteristics, can provide a cutting surface with a greater physiological shape and less curling of the edge, and should be recommended as a general standard method for tailoring complex demarcation.

Methods

The ethics committee of the Jiangsu Province People's Hospital approved this study, and individual patient consent was waived according to institutional guidelines.

From 2013 January to 2017 December, 722 patients with lung nodules < 2 cm underwent anatomical segmentectomy at Jiangsu Province People's Hospital. Surgical indications were confirmed to comply with guidelines before surgery. Dissection of the targeted segment bronchus, artery, and intrasegmental vein was guided by three-dimensional computed tomography bronchography and angiography. Intersegmental demarcation was achieved using a modified inflation-deflation method.⁴ A sharp-blunt combined dissection along the demarcation was then performed to complete the anatomical segmentectomy. The dissection course included three critical steps: excavating the “work-plane,” opening the “gate,” and tailoring along the demarcation (see combined subsegmentectomy in Fig 1 and Video S1). Firstly, the targeted segment root was dissected deeply along the demarcation by grasping

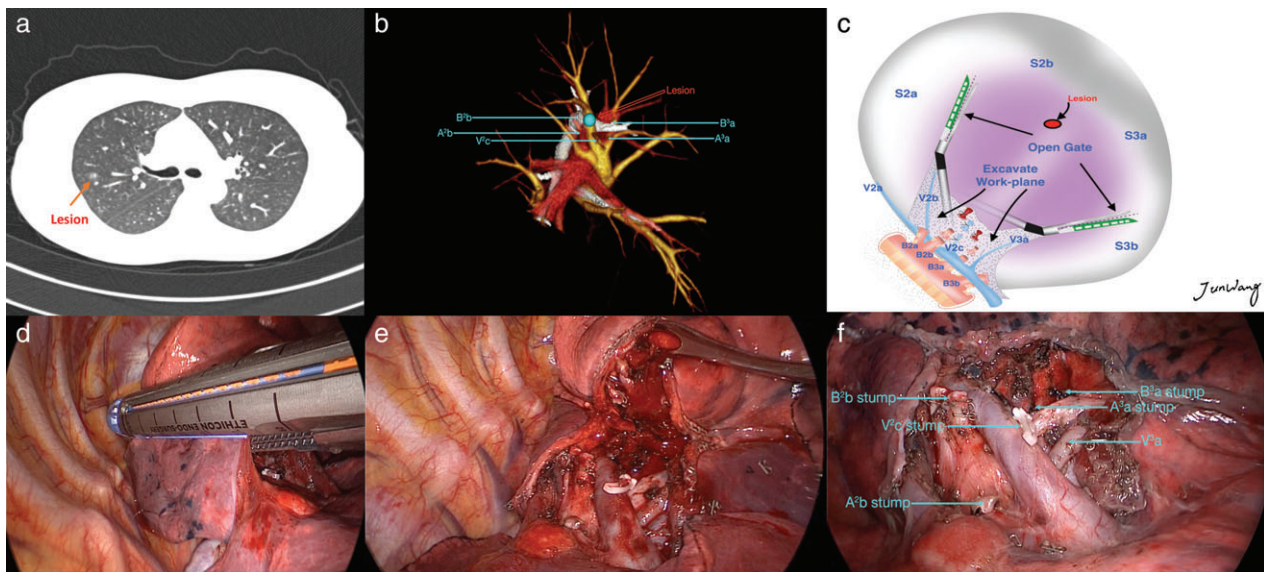


Figure 1 Details of the tailoring technique along inflation-deflation demarcation in lung segmentectomy. (a) Axial computed tomography and (b) three-dimensional images. (c) Illustration of the “work-plane” excavation and “gate” opening techniques. (d) Practical application of the gate opening technique during tailoring process. (e) The gate was opened at lateral wall of the work-plane. (f) The residual tailoring plane.

and lifting the distant stumps of anatomical structures to excavate a “work-plane,” which was then extended to one-third of the peripheral border. Secondly, two “shots” were fired to open the “gate” of the targeted segment – specifically, by inserting the anvil of the stapler into the lateral side of the “work-plane” along the inboard inflation-deflation demarcation, with the nail box compressing the superficial surface of the targeted segment along the outboard demarcation, two shots at each lateral wall of the “work-plane” opened the “gate” of the cone-shaped targeted segment. Thirdly, with explicit exposure, the peripheral residual border was tailored with a stapler by adjusting the route under guidance of the demarcation and intersegmental vein orientation.

Results

A total of 722 patients underwent 733 resections, including 545 segmentectomies, 175 subsegmentectomies, and 13 sub-subsegmentectomies for 604 malignant and 140 benign nodules (Table S1). Intersegmental borders included 280 simple and 453 complex types. The average diameter of the tumor was 1.6 ± 0.4 cm, and the average cutting edge was 2.8 ± 1.1 cm. The mean blood loss was 50.2 ± 21.5 mL. The mean duration of drainage was 3.7 ± 1.4 days. Postoperative complications related to surgery occurred in 53 cases (7.3%): prolonged air leak in 18 cases, hemoptysis in 21, chylothorax in 4, and pulmonary infection in 10. All patients recovered after conservative management. One case of incision bleeding and two

cases of chylothorax underwent reoperation. Three cases with an insufficient margin of < 2 cm or less than the diameter of the tumor underwent extended resection.

Discussion

Anatomical segmentectomy involves many refined details developed from clinical practice. One of the hardest parts is the accurate dissection of the intersegmental border. For a simple type border, such as the one between the superior and basal segments, the demarcation is easy for stapler cutting. For a complex curved border, with typically lateral basal segments or some combined subsegments, tailoring with the stapler alone will cause severe crush and curling of the cutting edge and subsequent atelectasis or venous pleonemia of the retained segments. Our method, for the first time, explicitly specifies the applied range of stapler and electrocautery with a sound basis of anatomical theory. The intersegmental connective tissue of the septum lobulae wears off from the hilum to the costal surface⁵ and causes intense intercommunication of the pulmonary alveoli in one-third of the peripheral parenchyma. Thus, extending the “work-plane” in internal adjoining parenchyma with electrocautery is suitable. After opening the lateral “gate” to decrease the camber of the demarcation near the costal surface, stapler tailoring of the relatively thin peripheral parenchyma can then reduce air leak, bleeding, and the curling effect caused by linear cutting on the costal convex of the lung. This technique has gone through a gradual process of development since 2016 when we began to focus

on the cone-shaped anatomical feature of lung segments. From the initial dissection of the cone tip (i.e. the segment hilum), to excavation of the work-plane, to the gate-opening concept, all improvements were developed from experience of full sharp dissection or full stapler cutting. The method evolved in our center incorporates the merits of stapler tailoring and electrocautery cutting. Although it is not mandatory to follow all steps above for all segmentectomies, in segments with multiple curved intersegment borders this technique can present a more physiological separation surface and minimize the risk of compression. This technique also displays advantages in cases of subsegmentectomy and sub-subsegmentectomy. Notwithstanding the relatively small “gate,” because of the width of the stapler anvil and the size of the targeted segment, without this technique, it would be no different to a wedge resection.

The limitations of this study include single-center data and a lack of statistical data analysis with other methods. Particularly noteworthy is that three cases with an insufficient margin, two with margins < 2 cm, and one with a margin less than the diameter of the tumor, all resulted from excessive pursuit of preservation of the intersegmental vein. Therefore, the radical resection of a tumor must be the premise when trying to preserve intersegmental veins.

During the tailoring course in lung segmentectomy, tips including good exposure of intersegmental demarcation, sharp-blunt combined dissection skill, “work-plane” extension, and “gate” opening techniques, all contribute to an accurate segmentectomy. This technique is safe and suitable for nearly all segments, but is particularly favorable for segmentectomies with complex borders.

Acknowledgments

This study was supported in part by Jiangsu Province Natural Science Foundation (BK20151584), Jiangsu Top

Expert Program in Six Professions (WSW-028) and Jiangsu Province key research and development plan (BE2016789, BE2018746). The authors are grateful to all of the individuals who participated in the treatment of this case.

Disclosure

No authors report any conflict of interest.

References

- 1 Nakazawa S, Shimizu K, Mogi A, Kuwano H. VATS segmentectomy: Past, present, and future. *Gen Thorac Cardiovasc Surg* 2018; **66**: 81–90.
- 2 Asakura K, Izumi Y, Kohno M *et al.* Effect of cutting technique at the intersegmental plane during segmentectomy on expansion of the preserved segment: Comparison between staplers and scissors in ex vivo pig lung. *Eur J Cardiothorac Surg* 2011; **40**: e34–48.
- 3 Ramsay B II. The anatomic guide to the intersegmental plane. *Surgery* 1949; **25**: 533–8.
- 4 Wang J, Xu X, Wen W, Wu W, Zhu Q, Chen L. Modified method for distinguishing the intersegmental border for lung segmentectomy. *Thorac Cancer* 2018; **9**: 330–3.
- 5 Yamashita H. *Roentgenologic Anatomy of the Lung*. Igaku-shoin, Tokyo, New York 1978.

Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher’s website:

Table S1. Location of the resected segments

Video S1. Details of the tailoring technique along inflation-deflation demarcation in lung segmentectomy.