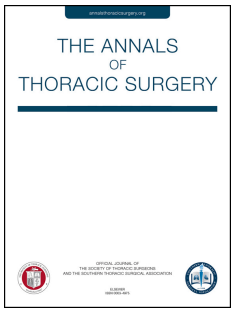
Journal Pre-proof



An economical and available solution for surgical smoke in video-assisted thoracic surgery

Huiqin Guo, MD, PhD, Xin Wang, MD, Weiqing Li, MD, PhD, Jianlu Zhang, MD

PII: S0003-4975(21)01050-X

DOI: https://doi.org/10.1016/j.athoracsur.2021.06.004

Reference: ATS 35346

To appear in: *The Annals of Thoracic Surgery*

Received Date: 13 April 2021

Revised Date: 27 May 2021

Accepted Date: 1 June 2021

Please cite this article as: Guo H, Wang X, Li W, Zhang J, An economical and available solution for surgical smoke in video-assisted thoracic surgery, *The Annals of Thoracic Surgery* (2021), doi: https://doi.org/10.1016/j.athoracsur.2021.06.004.

This is a PDF file of an article that has undergone enhancements after acceptance, such as the addition of a cover page and metadata, and formatting for readability, but it is not yet the definitive version of record. This version will undergo additional copyediting, typesetting and review before it is published in its final form, but we are providing this version to give early visibility of the article. Please note that, during the production process, errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

© 2021 by The Society of Thoracic Surgeons

Journal Pre-proof

An economical and available solution for surgical smoke in video-assisted thoracic surgery

Running Head: Solution for surgical smoke

Huiqin Guo*[1], MD, PhD, Xin Wang*[2], MD, Weiqing Li*[1], MD, PhD, Jianlu Zhang[3], MD

1. Department of Thoracic Surgery, Beijing Shijitan Hospital, Capital Medical University/ Peking University Ninth School of Clinical Medicine, Beijing, China.

2. Department of Clinical Medicine, Medical College of Qinghai University, Xining, China.

3. Department of General Surgery, Beijing Shijitan Hospital, Capital Medical University/ Peking University Ninth School of Clinical Medicine, Beijing, China.

*Drs Guo, Wang and Li contributed equally to this work.

Corresponding author: Jianlu Zhang, MD, Department of General Surgery, Beijing Shijitan Hospital, 10 Tieyi Road, Yangfangdian Street, Haidian District, Beijing 100038, China. Email: 1911210737@pku.edu.cn

Journal Pre-proof

Journal Pre-proof

Abstract

During video-assisted thoracic surgery, surgical smoke can interfere with surgeons' vision and attention. In addition, the harmful substances in the surgical smoke also threaten the health of surgical staff. In practice, we designed an economical and available solution for the smoke in video-assisted thoracic surgery and got satisfactory results. This paper introduces the principle and procedure of this solution.

Key words: surgical smoke; video-assisted thoracic surgery; surgical innovation

Journal Pre-proof

During video-assisted thoracic surgery (VATS), smoke generated from electro-surgical equipment can interfere with the vision of surgeons and further increase the risk of harm during surgery. Furthermore, there are many kinds of pathogenic and irritant substances in the smoke, such as carbon monoxide, acrylonitrile, hydrogen cyanide, formaldehyde, benzene, various particulate matters, etc.[1,2] The pungent smoke that overflows from the cavity can not only hinder the attention of surgical staff, but also threaten their health[2,3]. During an operation, assistants often need to use an aspirator to suck out the smoke. This slows down the surgical process and wastes human resources. In addition, smoke can carry living bacteria, viruses and cells.[2,4,5] Many reports have expressed legitimate concern about the risk of viral or bacterial infection among surgical staff from surgical smoke in operating rooms. Especially during the COVID-19 worldwide pandemic, such reports become more frequent.[6,7,8]

To alleviate the problem of surgical smoke, scholars from all over the world have come up with a variety of interesting solutions.[6,8] However, most solutions focus on the issue of surgical smoke during laparoscopic surgery, and there has been little research on the issue of smoke during VATS. As we all know, almost all VATS do not require the establishment of air cavity, and there is no need to worry about the aerosol caused by carbon dioxide airflow. However, in VATS, especially in the single-incision thoracoscopic surgery, a protective sleeve rather than a port must be placed at the incision to perform surgery. So the smoke evacuation devices linked to the valve of the port, like those used in laparoscopic surgery, are useless.[6,8] In order to resolve thees problems, we designed an economical and available smoke extraction method using existing materials and applied successfully in VATS lobectomy.

Technique

The same surgical position and anesthesia are used as for conventional VATS. After the chest was opened and the lung was collapsed, the needle of a sterilized intravenous line tube was inserted through the intercostal space into the thoracic cavity under the surveillance of the thoracoscope. Then, the other end of the line tube was connected to the suction tube (*Figure 1*). Thus, a relative negative pressure was developed in the thoracic cavity, and the smoke generated in the thoracic cavity could be discharged through the intravenous line tube and the suction tube into the hospital central vacuum suction system (*Video*).

Patients

Thirty patients who underwent VATS lobectomy for lung tumor were included in this study. The age of the patients was 66 [42-85] years old, body mass index was 24.3 ±

3.2 kg/m^2, and the tumor diameter was 1.79 ± 0.81 cm. The operation time, blood loss and intraoperative complications were calculated. (This study has been approved by the Ethics Committee of Beijing Shijitan Hospital, Capital Medical University, China, and informed consent was obtained from patients.)

Results

All patients underwent surgery successfully, the operation time was 85.24 ± 22.31 min, the blood loss was 43.56 ± 19.32 ml, and no accident nor intraoperative complication occurred. During the operation, the technique was very useful with high smoke extraction efficiency. Using the smoke extraction technique can keep the vision clear, reduce the pungent odors , and avoid the interruption of surgery and the waste of human resources caused by repeatedly using the aspirator to remove the smoke and lens wiping.

Comment

There are some advantages of this method. First, this method uses conventional intravenous line tube and suction tube, which are very cheap and available. Second, this method is simple and easy to learn, which can save precious operation time. Third, the harmful smoke is discharged to the hospital central vacuum suction system where there is a very sophisticated waste gas treatment equipment, which can reduce the pollution to the operating room. Forth, there is no need to stitch the chest wall after the needle is removed and no scar will be left on the skin, since the needle is very thin.

With the deepening of the application, we've come up with some tips. First of all, the needle should not be inserted too deep (preferably just emerging from the parietal pleura) and should avoid blood vessels, pericardium, and lung. Secondly, the needle should be placed away from the lens so that smoke does not flow to the lens. Finally, the combination of safety intravenous catheter (diameter: 16G, 1.7mm) and suction tube is also recommended for patients with a thick chest wall (*Figure 2*). Moreover, compared with metal needle, the soft intravenous catheter can also provide a greater sense of security.

Journal Pre-proof

References

1. Brace MD, Stevens E, Taylor SM,et al.. 'The air that we breathe': assessment of laser and electrosurgical dissection devices on operating theater air quality. J Otolaryngol-Head N. 2014;43:39.

2. Limchantra IV, Fong Y, Melstrom KA. Surgical Smoke Exposure in Operating Room Personnel: A Review. JAMA Surg. 2019;154(10):960-967.

3. Choi SH, Kwon TG, Chung SK, et al. Surgical smoke may be a biohazard to surgeons performing laparoscopic surgery. Surg Endosc. 2014;28(8):2374–2380.

4. Kwak HD, Kim SH, Seo YS, Song KJ. Detecting hepatitis B virus in surgical smoke emitted during laparoscopic surgery. Occup Environ Med. 2016;73(12):857-863.

5. Hu X, Zhou Q, Yu J, et al. Prevalence of HPV infections in surgical smoke exposed gynecologists. Int Arch Occup Environ Health. 2021;94(1):107-115.

6. Mintz Y, Arezzo A, Boni L, et al. A Low-cost, Safe, and Effective Method for Smoke Evacuation in Laparoscopic Surgery for Suspected Coronavirus Patients. Ann Surg. 2020;272(1):e7-e8.

7. Mowbray NG, Ansell J, Horwood J, et al. Safe management of surgical smoke in the age of COVID-19. Br J Surg. 2020;107(11):1406-1413.

8. Zhang J, Zhu B. Comment on: Underwater-seal evacuation of surgical smoke in laparoscopy during the COVID-19 pandemic: A feasibility report of a simple technique. Br J Surg. 2021;znab031. doi:10.1093/bjs/znab031 [published online ahead of print, 2021 Feb 9]

Journal Pre-proof

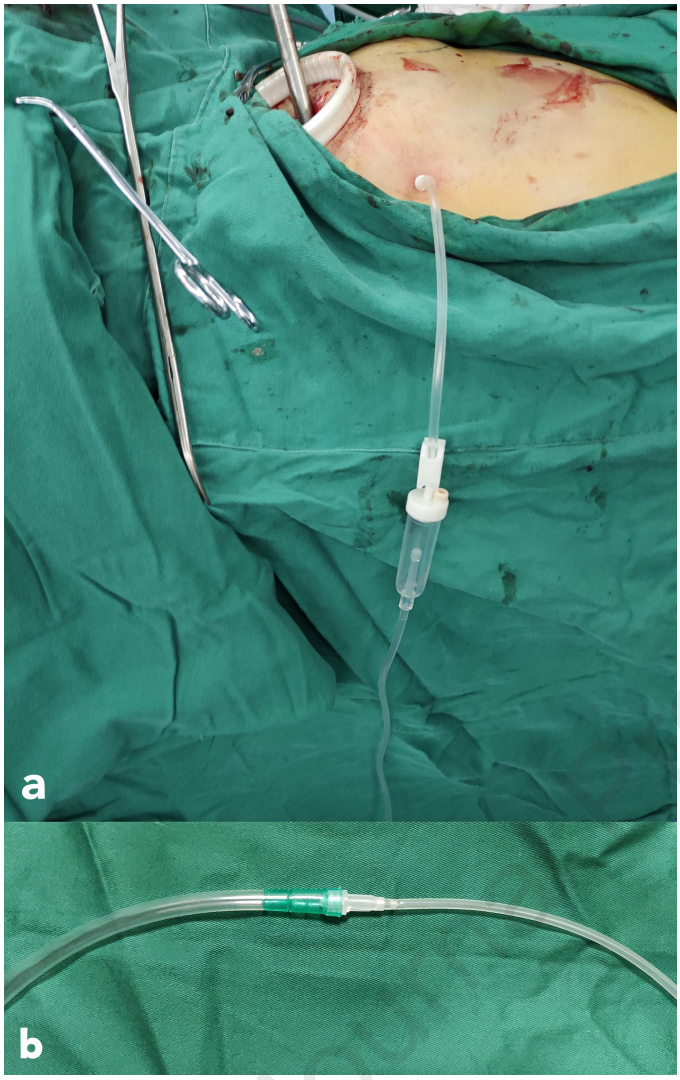
Journal Pre-proof

Figure Legends

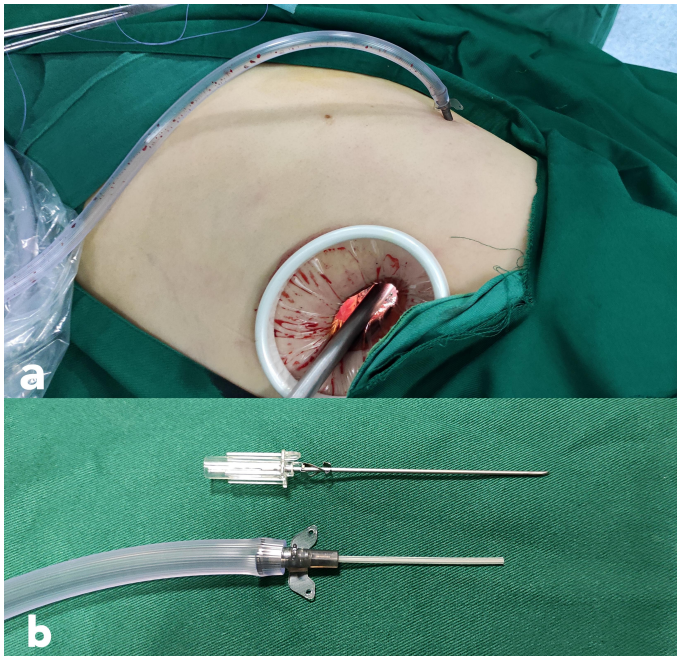
Figure 1. The intraoperative photograph of the technique. (a) intraoperative photograph; (b) method of connection between the end of the line tube and the suction tube.

Figure 2. The combination of safety intravenous catheter and suction tube. (a) intraoperative photograph; (b) method of connection between safety intravenous catheter and suction tube.

Journal Pre-proof



Journal Pre-proof



Journal Pre-proof