

A Low-cost, Safe, and Effective Method for Smoke Evacuation in Laparoscopic Surgery for Suspected Coronavirus Patients

Yoav Mintz, MD,* Alberto Arezzo, MD,† Luigi Boni, MD,‡ Manish Chand, MD,§ Ronit Brodie, MPAS,* and Abe Fingerhut, MD¶|||✉, and the Technology Committee of the European Association for Endoscopic Surgery**

Keywords: aerosol, filter, surgical smoke, Covid-19, laparoscopic surgery, coronavirus

(Ann Surg 2020;272:e7–e8)

Due to the recent COVID-19 pandemic, the debate regarding the safety of smoke evacuation during laparoscopic procedures and whether viruses can be aerosolized during such procedures has resurfaced.¹

While the National Institute for Occupational Safety and Health Administration does not specifically require the use of smoke evacuation and filtering systems during laparoscopy,² major concerns for surgical staff safety have been raised concerning all aerosol generating procedures (AGP). Since hepatitis B virus (HBV) has previously been demonstrated to be present in surgical smoke in 10 out of 11 HBV positive patients,³ it is feared that the Covid-19 virus could also be disseminated during AGPs and potentially infect the surgical staff.

Although the COVID-19 virus (SARS-CoV-2) has not yet been detected in AGPs, care should be taken to reduce the risk of surgical staff infection in the operating room. In experimental conditions SARS-Cov-2 has recently been shown to have aerosol and fomite transmission potential similar to SARS-Cov-1 (the most

closely related human virus), in particular remaining in aerosols for 3 hours or more and on surfaces for up to 72 hours.⁴ In anticipation of a substantial amount of operations in the near future of COVID-19 carriers and infected patients, a simple and effective measure for the evacuation and entrapment of smoke and aerosol is needed. Due to collapsing economies and limited availability for appropriate filter equipment within this pandemic, we suggest the use of a simple, very low-cost filtration system with readily available components in the operating room for immediate implementation. Standard electrostatic filters used for ventilation machines have the capability of filtering known bacterial and viral loads with great efficiency⁵ and most are certified for 99.99% effective protection against HBV and hepatitis C virus which have a diameter of 42 nm and 30 to 60 nm respectively.⁶ SARS-CoV-2 has a larger diameter of 70 to 90 nm⁷ therefore the same filtering efficiency can be expected to apply for new virus. This filter can be connected via standard tubing to the trocar evacuation port to constitute an evacuation and filtering system which evacuates the generated smoke, as well as filter the potential viral load to ensure surgical staff safety. To connect the filter to the tubing we use the endotracheal tube connector (Fig. 1A, B). No active suctioning is attached to this system.

Following simple bench top studies evaluating the capability of evacuating smoke effectively, the system was recently used clinically in 5 operations including cholecystectomy, inguinal hernia repair, Total Mesorectal Excision, Transanal Total Mesorectal Excision, and anterior resection of the rectum by surgeons in Israel and Italy.

Consulted online via the current social media possibilities, all surgeons within the European Association for Endoscopic Surgery technology committee reported simple and quick assembly of the system as well as very good efficiency of smoke evacuation during their laparoscopic procedures. As this is a passive system, it is recommended to use short and wide tubing to decrease flow resistance. The filter system should be discarded according to hospitals' protocols for infection control.

Dissemination of knowledge and exchange of ideas about this rapidly spreading infection is crucial to healthcare workers globally. Findings and guidelines are quickly being published and frequently updated by relevant learned societies such as the American College of Surgery, the Society of American Gastrointestinal and Endoscopic Surgeons, and the Royal College of Surgeons^{8–10} to update surgeons dealing with COVID-19. Although the Royal College of Surgeons of Edinburgh published important guidance of surgical care to protect patients and surgeons,¹⁰ we disagree with the statement that laparoscopy should be avoided. Provided a simple, safe, and reliable filtering and evacuation system for pneumoperitoneum gases is used, and that strict precautions are abided to, laparoscopy is potentially preferable to open surgery, where smoke contamination is uncontrollable. Suggestions such as instrument cleaning during surgery, deflating pneumoperitoneum prior to removing trocars, conversion or specimen extraction, as highlighted by the Chinese and Italian experience, are particularly helpful.¹

From the *Department of General Surgery, Hadassah Hebrew University Medical Center, Jerusalem, Israel; †Department of Surgical Sciences, University of Torino, Torino, Italy; ‡Department of Surgery, Fondazione IRCCS—Ca' Granda, Ospedale Maggiore Policlinico, University of Milan, Milan, Italy; §Welcome EPSRC Centre for Interventional and Surgical Sciences (WEISS), University College London, London, UK; ¶Department of General Surgery, Ruijin Hospital, Shanghai Jiao Tong University School of Medicine, Shanghai Minimally Invasive Surgery Center, Shanghai, P. R. China; ||Section for Surgical Research, Department of Surgery, Medical University of Graz, Graz, Austria; and **The Technology Committee of the EAES is composed of: Thomas Carus, General, Visceral, and Vascular Surgery, Asklepios Westklinikum Hamburg, Germany. Michele Diana, Institute of Image-Guided Surgery, IRCAD, Research Institute against Cancer of the Digestive System, Strasbourg, France. Fanny Ficuciello, Università di Napoli Federico II, Napoli, Italy. Tim Horeman, Delft University of Technology, Delft, The Netherlands. Stefania Marconi, Department of Civil Engineering and Architecture, University of Pavia, Pavia, Italy. George Mylonas, Human-centred Automation Robotics and Monitoring in Surgery (HARMS) Lab, Imperial College, London, UK. Young Woo Kim, National Cancer Center, Goyang, South Korea. Kiyokazu Nakajima, Department of Next Generation Endoscopic Intervention, Osaka University Graduate School of Medicine, Osaka, Japan. Felix Nickel, Department of General, Visceral, and Transplant Surgery, Heidelberg University, Heidelberg, Germany. Chen Sagiv, Co CEO SagivTech Ltd, Raanana, Israel. Marlies Schijven, AMC – Academic Medical Centre, Amsterdam, The Netherlands. Pietro Valdastrì, Institute of Robotics, Autonomous Systems and Sensing, School of Electronic and Electrical Engineering, University of Leeds, Leeds, UK.

✉abefingerhut@aol.com.

The authors report no conflicts of interest.

Supplemental digital content is available for this article. Direct URL citations appear in the printed text and are provided in the HTML and PDF versions of this article on the journal's Web site (www.annalsofsurgery.com).

Copyright © 2020 Wolters Kluwer Health, Inc. All rights reserved.

ISSN: 0003-4932/20/27201-00e7

DOI: 10.1097/SLA.00000000000003965

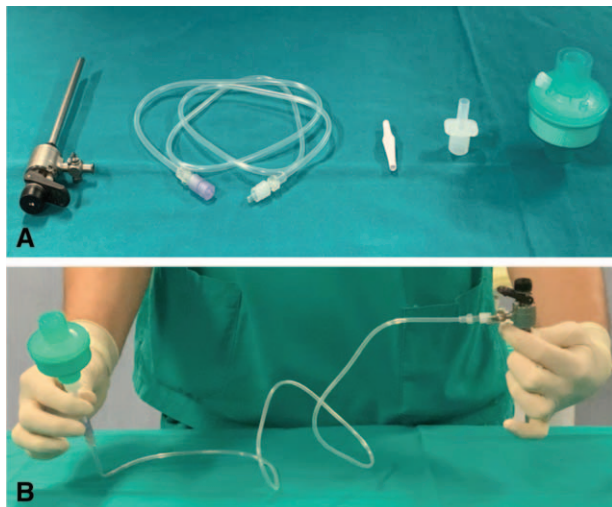


FIGURE 1. (A) All the standard OR equipment needed to assemble the system including ventilation machine filter, endotracheal tube connector, drainage tube connector, and IV tubing; and (B) the complete filtering system assembled.

Social media is essential and largely used for exchange of experiences and fast implementation worldwide. Websites of leading societies like Society of American Gastrointestinal and Endoscopic Surgeons, European Association for Endoscopic Surgery, American College of Surgery are updated daily, while surgeons share their own experiences and ideas via Twitter, LinkedIn, and Facebook which instantly disseminate knowledge. Videos demonstrating assembling of the filtering system (video 1, <http://links.lww.com/SLA/C205>) and its effectiveness during laparoscopic operations (video 2, <http://links.lww.com/SLA/C206>)

are attached and can be used for wide-spread dissemination. Eagerly awaited are clinical data to determine if this proposed solution is effective in preventing contamination in the operating room or not.

REFERENCES

1. Zheng MH, Boni I, Fingerhut A. Minimally invasive surgery and the novel coronavirus outbreak: lessons learned in China and Italy. *Ann Surg.* 2020 [Epub ahead of print].
2. The National Institute for Occupational Safety and Health. Control of smoke from laser/electric surgical procedures. 1996; Available at: <https://www.cdc.gov/niosh/docs/hazardcontrol/hc111.html>. Accessed on March 27, 2020
3. Kwak HD, Kim S-H, Seo YS, et al. Detecting hepatitis B virus in surgical smoke emitted during laparoscopic surgery. *Occup Environ Med.* 2016;73:857–863.
4. van Doremalen N, Bushmaker T, Morris DH, et al. Aerosol and surface stability of SARS-CoV-2 as compared with SARS-CoV-1. *N Engl J Med.* 2020 [Epub ahead of print].
5. Dellamonica J, Boisseau N, Goubaux B, et al. Comparison of manufacturers' specifications for 44 types of heat and moisture exchanging filters. *Br J Anaesth.* 2004;93:532–539.
6. Baron S, Fons M, Albrecht T. Viral Pathogenesis. In: Baron S, editor. *Medical Microbiology.* 4th edition. Galveston (TX): University of Texas Medical Branch at Galveston; 1996. Chapter 45.
7. Kim JM, Chung YS, Jo HJ, et al. Identification of coronavirus isolated from a patient in Korea with COVID-19. *Osong Public Health Res Perspect.* 2020;11:3–7.
8. The American College of Surgeons. *ACS COVID-19 and Surgery.* March 24, 2020; Available at: <https://www.facs.org/covid-19/clinical-guidance>. Accessed March 27, 2020.
9. The Society of American Gastrointestinal and Endoscopic Surgeons. *SAGES Recommendations Regarding Surgical Response to COVID-19 Crisis 2020;* Available at: <https://www.sages.org/recommendations-surgical-response-covid-19/>. Accessed March 27, 2020.
10. The Royal College of Surgeons. *Updated Intercollegiate General Surgery Guidance on COVID-19.* 2020; Available at: <https://www.rcseng.ac.uk/coronavirus/joint-guidance-for-surgeons-v2/>. Accessed March 27, 2020.