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

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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 (NIOSH) 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 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 efficiency [5] and most are certified for 99.99% effective protection against HBV and HCV which have a diameter of 42nm and 30-60 nm respectively [6]. SARS-CoV-2 has a larger diameter of 70-90 nm [7] 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. In order to connect the filter to the tubing we use the endotracheal tube connector (figure 1a, 1b). 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 five operations including cholecystectomy, inguinal hernia repair, Total Mesorectal Excision (TME), Transanal Total Mesorectal Excision (taTME), 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 (EAES) 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 (ACS), the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES),

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and the Royal College of Surgeons (RCS) [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].

Social media is essential and largely used for exchange of experiences and fast implementation worldwide. Websites of leading societies like SAGES, EAES, ACS 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) and its effectiveness during laparoscopic operations (video 2) 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.

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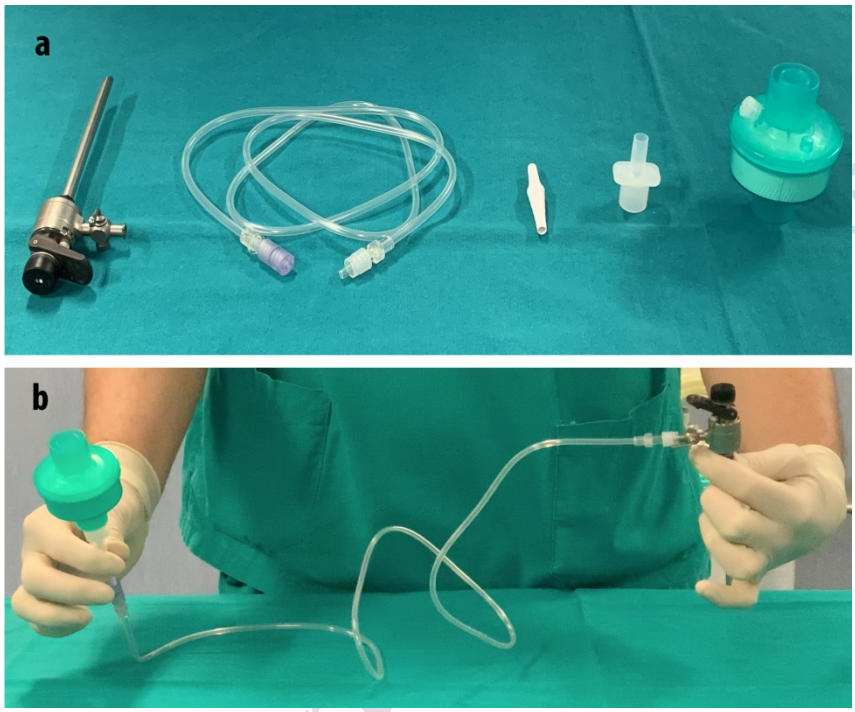
Figure legends
Figure 1 –(a) all the standard OR equipment needed to assemble the system including ventilation machine filter, endotracheal tube connector, drainage tube connector and IV tubing and (b) the complete filtering system assembled



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