

Innovative Technique to Control the COVID-19 Transmission by Laparoscopic Fume: Could It be Possible to Capture the Betal inside the Bottle?

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ABSTRACT

Aim and objective: This article aims to conceptualize the modification in the laparoscopic port to minimize the risk of COVID-19 virus transmission through the aerosol during laparoscopic procedures.

Background: A recent situation of COVID-19 pandemic has produced so many new unknown challenges for surgeons. Surgical fume is a known theoretical biohazard for the operating team. There are many suggestions from the international and national surgical societies and already available equipment which could minimize the risk transmission. Still, there is no technique available to contain and discharge surgical fume in the proper way. Here, we conceptualize a technique to reduce the risk of COVID-19 transmission in the operating team.

Technique: Here, we have suggested the modification in the laparoscopic port. We advise adding an intermediate transparent, pliable, polythene/silicon bag that could able to contain the leaked surgical fume and safely discharge in an underwater seal bottle, filled with sanitizer liquid.

Conclusion: The theoretical, potential risk of COVID-19 transmission during laparoscopic surgery has raised many doubts and apprehension of virus transmission through the surgical fume. There are many suggestions and available equipment to minimize the spread; however, no definite solution already out surgical fume; here, our suggestion of modification in port could be a permanent solution to the surgical fume problem. However, this is an initial concept that has the potential to addition and suggestion to improve the technique.

Clinical significance: The theoretical risk of surgical fume causing COVID-19 virus transmissions completely changes our surgical practice. Here, in this article, we suggested our concept and technique contain and safely discharge of surgical fume during laparoscopic surgery.

Keywords: COVID-19, SARS-CoV-2, Surgical smoke, Viral transmission.

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BACKGROUND

The recent scenario of the COVID-19 pandemic has changed the indications of emergency surgery and has been making significant changes in the algorithm of surgical disease management. The theoretical concern of COVID-19 viral transmission during open or laparoscopic surgeries is the main topic of debate in a recent situation. There are known advantages of minimally invasive surgery, e.g., less postoperative pain, early recovery, shorter hospital stay, in turn, is increasing availability of beds in limited recourses and ultimately better outcomes.¹ However, we are unable to take the full advantages of laparoscopic surgery in the COVID-19 pandemic due to concern of virus transmission through surgical fume. Laparoscopic surgery provides a self-contained operative field which significantly minimized the risk of direct contact with biological fluid or tissue.² There are many suggestions and available equipment to minimize the risk of transmission. However, no advice or device contained unavoidable leaked fume which is already out from the abdominal cavity. Here, in this article, we conceptualized and proposed the technique to contain and discharge the surgical fume.

TECHNIQUE

Concept behind This Technique

All reported advantages of laparoscopic surgery over open surgery in the COVID-19 scenario, in terms of shorter hospital stay and less chance of spread of infection (fewer chances of exposure to biological fluids and tissue are taken away from due to a

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theoretical risk of COVID-19 transmission). This is theorized that aerosol and fume generated during the use of energy sources may cause transmission of virus infection. There are few steps during laparoscopic surgery where the operating team might come in contact with aerosol/surgical fume.

- At the time of insertion of the first port where the pneumoperitoneum created with a closed technique.
- Insertion of other ports for instruments or cameras.
- Repeated insertion of scope or instruments during the procedure (where CO₂ can leak by the side of the instrument).
- The usual practice of deflation CO₂ through the stopcock at the time of repeated fogging of a camera lens.
- At the end of the procedure during deflation of the abdomen.

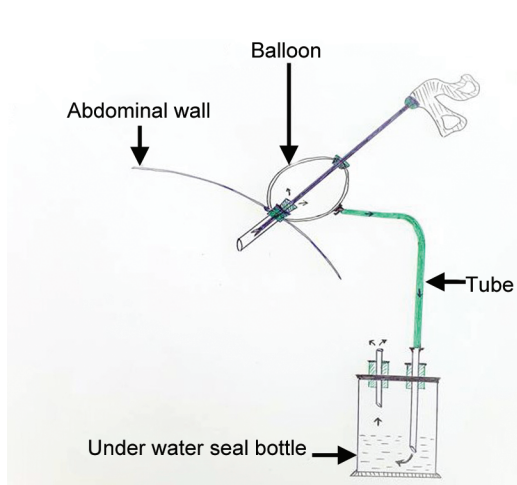


Fig. 1: Proposed concept of an innovative technique to contain and discharge the surgical fume

Two main goals to control surgical fume during laparoscopic surgery.

- Containment of leaking, CO₂/aerosol fume during a laparoscopic procedure, and deflation.
- Safe discharge of surgical fume/CO₂.

Chance of further leak is less?

- The volume of the leak will be less in comparison to abdominal CO₂ gas volume and continuously discharging in an underwater seal bottle.
- The pressure inside the balloon is less as compared to the inside of the abdomen (compressed air).
- All surgical fume/CO₂ collected inside the balloon could also be drained underwater seal bottle intermittently.

Here, we have suggested modification in laparoscopic port to contain the surgical fume by placing intermediate reservoir balloon on which could be pliable and transparent to allowed hazel free insertion and movements of the instrument during the laparoscopic procedure and with one outlet nozzle (with stopcock) for controlled discharge of surgical fume in underwater seal bottle which is already filled with sanitizer/viricidal liquid. Underwater seal drain prevents the backflow of fume and filled viricidal liquid could be able to kill the virus (Fig. 1).

Here, we utilized Jackson–Pratt abdominal drain to make a prototype of this device. We utilized a drain bulb (pliable and transparent) for purpose of the intermediate reservoir balloon and have an outlet port and tube with stopper for control discharge of fume. As shown in Figures 2 and 3, we placed the port sleeve through the inside of the balloon and another (shorten) same size port sleeve with cannula handle in the opposite wall of a balloon in the same trajectory. Here, we have to place the laparoscopic instrument through the outer port go through the balloon, inner port then inside the abdominal cavity, which allows us to collect the leak fume inside the balloon and could discharge in water seal intercostal drain (ICD) bottle that is already filled with viricidal liquid. The above modification in the laparoscopic port might be able to stop any egress of any aerosol during all steps of laparoscopic surgery in the operation theater atmosphere.

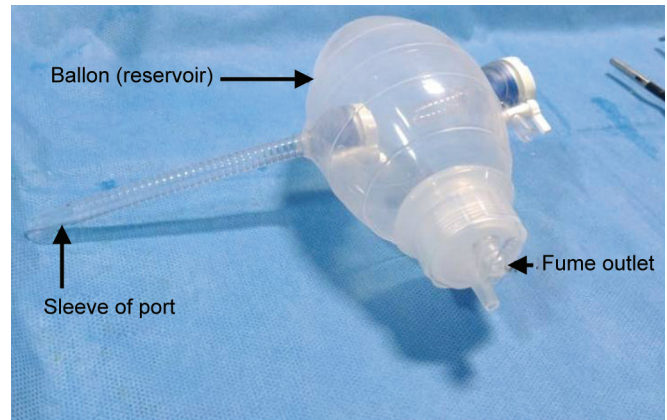


Fig. 2: Modified port: Made by Jackson–Pratt abdominal drain bulb

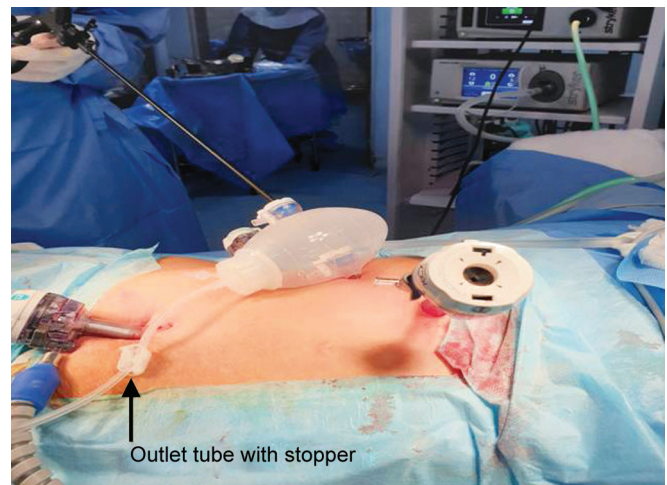


Fig. 3: Performing a laparoscopic procedure with a modified laparoscopic port

DISCUSSION

The scenario of the COVID-19 pandemic has completely changed the surgical practice due to doubts and the risk of transmission during surgical procedures. The vulnerability of virus transmission forces the surgeon communities to make changes in their strategies and adopt innovative safety practices. There are well-documented advantages of laparoscopic surgery, e.g., short hospital stay (more availability of a bed in limited resources in the recent scenario) and self-content operative field which further decreases the chances of viral transmission. The theoretical risk of COVID-19 transmission during laparoscopic surgery due to compressed CO₂ leak or fume/aerosol, form during the use of energy source created invalidated doubt and fear. The risk of transmission is not only limited to laparoscopic surgery, open surgery also has equal chances of transmission of COVID-19 due to direct contact of the intestinal mucosa, biological fluid, and surgical aerosol formed during the use of energy sources. Complete control of the peri-instrument leak of CO₂ (port leak) during the laparoscopic procedure is unavoidable. However, if anyhow we could able to contain aerosol and discharge in control way then we could possible to avoid leakage and could get all the advantages of minimally invasive surgery.

There are several reports where the virus, e.g., hepatitis B virus (HBV), human immunodeficiency virus (HIV), bovine papillomavirus, and human papillomavirus (HPV) harvest from surgical plume generated by energy sources. Most of the published reports on the risk of transmission seen *in vitro* analyzes. There are reports of HPV transmission during the treatment of laryngeal papillomatosis.³ Although there was no biological activity or transmission potential seen in obtained viral DNA.⁴ Although there are reports of viable HIV that have been harvested in cell culture; however, the potential risk of contamination by fume could not be able to prove,^{5,6} and there are not enough data available which able advice to differing the laparoscopic surgery or its replacement by open surgery.⁷

Although there are reports which suggested the presence of virus DNA in the laparoscopic plume; however, no study was able to prove their potential risk for transmission of viral. Several international and national surgical societies have suggested strategies and recommendations minimize the risk of transmission.

According to the Royal College of Surgeons, laparoscopy should only be considered in select individual cases. The Society of American Gastrointestinal and Endoscopic Surgeon (SAGES) states that in the recent pandemic, the use of filters for the released CO₂ during laparoscopy and robotic surgery should consider avoiding the COVID-19 transmission. There are many suggestions by experts and adopted strategies from surgical societies to decrease the risk of viral transmission. Most important is to avoid the traditional practice of opening port outlet stopcock at the time of fogging of a camera lens and uncontrolled deflation of the abdomen at the end of laparoscopic procedures. This entire maneuver should control and under the vision to avoid diffusion of surgical fume in the operation theater. Better to avoid the practice to reuse laparoscopic ports with a tear or damaged one-way valves during procedures.

There are many different insufflation systems and independent smoke evacuation system which could supplement with conventional insufflators in the present situation of COVID-19 pandemic. ConMed Air Seal® and PneumoClear are available integrated insufflators, PneumoClear has the added feature of controlled deflation at the end of the procedure.⁸ There is much advice from experts to decrease the chance of virus transmission. Operating on low intra-abdominal CO₂ volume and keeping insufflation pressure, lower than the standard 12–15 mm Hg^{9,10} looks more logical and feasible. This way we could able avoids gush of CO₂/fume during port manipulation/instrument exchange. Some experts also suggested keeping low settings of energy devices.

Although there are many suggestions given by surgical societies and experts, e.g., keeping energy sources on lower settings, keeping the low intra-abdominal CO₂ volume and low pneumoperitoneum pressure, and under vision evacuation of CO₂/surgical fume. However, there are no strategies to contain the surgical fume when it is already out through the port.

Here, we have described the technique where we can contain the fume in the transparent/pliable bag and could safely discharge in the sanitizer-filled (underwater seal) system.

CONCLUSION

The recent pandemic of the COVID-19 virus which highly contagious came with many challenges in the surgical field. Most important is the risk of transmission through aerosol/surgical fume produced during laparoscopic surgery. Here, we have not any evidence basis for the above statement; however, the existence of transmission cannot deny. There are so many suggestions and tactics by surgical

societies and experts and few already available devices to reduce fume leak. Still, there is a suggestion or solution to contain the fume/CO₂ which is already out from the abdominal cavity. Here, we conceptualized a technique to contain the leaked CO₂/aerosol and its safe discharge. This concept further needs addition and improvement could provide all advantages of laparoscopic surgery in a safe and fearless environment.

CLINICAL SIGNIFICANCE

COVID-19 pandemic came with a theoretical risk of surgical fume causing disease transmission. However, no reports mentioned that surgical fume could transmit the infection, yet we could not deny its existence till we find any further evidence basis. In this article, we have suggested an innovative technique to contain the surgical fume in an intermediate balloon and its proper discharge. We hope that our concept and technique would able to control surgical fume and provide a fearless and safe environment for the operative team.

DECLARATION OF PATIENT CONSENT

We have obtained consent from patients or close kin for the images and other clinical information to be reported in the journal. They understand that the names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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