# Stop the Smudge: A Novel Solution to Loss of Vision During Laparoscopic Colorectal Surgery

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**Background:** An obscured vision of surgical field during laparoscopic surgery is inconvenient. Several temporary methods were described as solutions to loss of vision, and common practice is scope removal, cleaning, and heating. A lately developed and introduced device claims continuous clear vision during laparoscopic surgery. This study aims to present our initial experience with the device during laparoscopic colorectal surgery.

**Materials and Methods:** We have included medical records of all patients scheduled for laparoscopic colorectal surgery with the device between March and August 2021 at Cleveland Clinic. Patient demographics, surgery type and time, the number of loss of vision events were recorded.

**Results:** Fifteen patients underwent laparoscopic colorectal surgery during the study period. The median age was 42 (range: 25 to 86) years, and 10 (66%) were female. The median surgery time was 127 (range: 67 to 240) minutes, and the median loss of vision event number was 3 (1 to 6) per surgery. There was no need for laparoscope removal during any of the surgeries. All surgeries were completed without any intraoperative complications.

**Conclusion:** The novel system, provides clear vision during laparoscopic colorectal surgery with no need of scope removal for loss of vision events. The system provides removal of particulate gathering on the tip of the scope.

**Key Words:** laparoscopic surgery, fogging, loss of vision

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Safe and efficient laparoscopic surgery is dependent upon good vision. Nevertheless, for laparoscopic surgeons, it is a common experience that operative vision may be critically reduced by material gathering on the distal laparoscopic lens.[1] This material has 2 main origins. Firstly, condensation accumulates due to the humidity of the intraperitoneal environment. Condensation can occur throughout the procedure but is almost inevitable when the relatively cold laparoscope is initially inserted into the abdominal cavity.[2] Second, particulate matter, such as blood and tissue debris, may accumulate. Such matter can be tenacious and difficult to remove. Particulates may also accumulate throughout the procedure but are most likely when the distal lens is positioned close to tissues during dissection. Often this is at a stage of the procedure when complex dissection is being performed. In colorectal practice, this is frequently in confined anatomic spaces, such as the pelvis, during rectal dissection. At such times, reduced vision, often occurring abruptly, impairs surgical safety and demands a pause in operative progress until vision can be restored.

Various methods have been described for restoring laparoscopic vision but common practice remains for the laparoscope to be removed from the abdomen for lens cleaning ex vivo. Although most surgical units will have their own technique, lens cleaning typically involves briefly soaking the laparoscope in sterile warmed saline to loosen particles, followed by direct cleaning the lens with a surgical swab and applying a de-fogging agent.[3] Although such maneuvers generally restore clear vision, each scope cleaning episode constitutes time during which operative progress is paused and the surgical attention is diverted from the task-in-hand, often at times when sustained concentration levels are needed. Multiple scope cleaning episodes typically needed during a laparoscopic procedure, with repeated pauses in operative progress, become frustrating for surgical teams. Such multiple pauses also constitute significant nonproductive time during any laparoscopic case. When considered across the many cases performed by a unit per year, many hours of surgery time are potentially lost.

The OpClear (Cipher Surgical Ltd., Coventry, UK) system presents an alternative solution to problems of laparoscopic vision, allowing rapid and effective cleaning of the distal laparoscope lens without the need for scope removal. The system offers the possibility of maintaining visual acuity throughout a laparoscopic procedure, minimizing nonproductive operating time.

## MATERIALS AND METHODS

We have reviewed the potential of a novel supplemental system claiming a solution to loss of laparoscopic vision in first 15 laparoscopic colorectal cases performed between March to August 2021 at Cleveland Clinic. All patients over 18, scheduled for laparoscopic colorectal surgery, willing to participate the study and able to comprehend the procedure were included. The study was approved by IRB. The number of scope cleaning events (loss of vision) was recorded.

The system is designed to remove condensation, tissue debris, and other particulate matter from the distal laparoscope lens without the need for laparoscope removal. The system works by delivering saline and high flow carbon

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The study was approved by institutional review board.

D.L. is consultant for Olympus. E.G. is consultant for Olympus, DiLumen, and Boston Scientific and receives honorarium from OpClear. The remaining authors declare no conflicts of interest.

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**FIGURE 1.** Control unit.

dioxide ($CO_2$) across the distal lens, washing and clearing matter from the optical surface. The system comprises a reusable control unit (Fig. 1) that manages $CO_2$ and sterile saline delivery to the laparoscope by a single-use 'C-clip' sheath (Fig. 2). The control unit is connected to a $CO_2$ source and then through tubing to the disposable sheath. The sheath, which is ethylene oxide sterilized for single use, is fitted over the laparoscope before commencing the laparoscopic procedure (Fig. 3). A refillable disposable 0.9% saline cartridge is also placed between the control unit and the sheath, saline flow being activated by $CO_2$ pressure from the control unit. The unit continuously monitors the delivered $CO_2$ and intra-abdominal gas pressure during the surgery. Using internal software, the control unit creates high-velocity $CO_2$ and saline flows, which are delivered through channels in the sheath to the distal laparoscopic lens. The system has 2 functions; an auto-demist function that provides a continuous $CO_2$ flow across the distal lens and a wash function providing a 2-second cycle delivering both $CO_2$ and saline. The wash function is activated, as required, by the surgeon by a foot switch. Through these functions, the system is designed to both continuously defog and provide lens cleaning as required with the laparoscope remaining in situ.

## RESULTS

Fifteen patients underwent laparoscopic colorectal surgery during the study period. The median age was 42 (range: 25 to 86) years, and 10 (66%) were female. Laparoscopic resections performed were: right hemicolectomy (n = 6), single-port total abdominal colectomy (n = 5), proctocolectomy (n = 2), segmental colectomy (n = 1), and Hartmann colostomy reversal (n = 1). The median surgery time was 127 (range: 67 to 240) minutes, and the median loss of vision event number was 3 (1 to 6) per surgery. There was no need for laparoscope removal during all surgeries. None of the patients had any intraoperative or postoperative complication due to device utilization.

**FIGURE 2.** C-clip attached over the scope.

**FIGURE 3.** C-clip and cartridge.

## DISCUSSION

The novel system, provided may ease the handling of loss of vision during laparoscopic surgery and facilitate precise laparoscopic colorectal surgery in North America. It is easy to set up, use and minimizes need for scope removal. It also provides good vision with reduced condensation and rapid removal of particulate matter. Studies on 2 comparative randomized patient groups with larger numbers and based on quantitative measures are needed to accurately assess the system benefit for fogging.

Typically obscured vision may arise due to lens condensation (fogging) or body/tissue products, such as blood, adipose tissue, smoke, etc. When vision loss occurs during laparoscopy, it can easily become frustrating for the surgical team. The visual impairment may produce surgical errors such as misuse or misplacement of laparoscopic devices. These situations definitely contribute to surgery time, adverse events and frustration of the team due to the repetitive efforts for maintaining clear vision. Thus, surgical teams put great efforts to eliminate this situation and to provide clear vision.

The etiology of lens condensation arises from difference in humidity and temperature in operating room and peritoneum; 50 versus 85% and 37 versus 20 to 24°C, respectively. Flemming and colleagues described the relationship between intraperitoneal humidity and scope tip temperature. They postulated and demonstrated no fogging event in case of 100% humidity when the scope tip is heated to 37°C.[4] The study also reported the intraperitoneal scope tip temperature may change depending on insufflation rate, length of surgery, laparoscope, and light source model, which all have different level of impact on lens temperature. The relationship between humidity and scope temperature is the mainstay of external heating of the scope during laparoscopic surgery. We also know even if the insufflated gas has 0% humidity, it becomes saturated intraperitoneally while reducing body temperature. Controversially, Davis et al[5] demonstrated heated and humidified $CO_2$ insufflation during laparoscopy is not indicated in a randomized clinical trial. The similar low success rate of insufflating humidified $CO_2$ flow was reproduced in other studies as well.[6] Practically, external heating and mechanical cleaning has the greatest impact on restoration, but we still do not know the exact mechanism of intra-abdominal fogging. Antifogging solutions and iodine based readily available solutions were utilized to prevent condensation derived loss of vison. The described solutions and similar commercial products decrease surface tension and maintain droplet spread away and ease evaporation.[7–10] In contrast, loss of vision due to


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body/tissue products occur during close vision of surgical steps where vision continuality becomes more important. Such steps in colorectal surgery are typically dissections performed close to vascular structures or at difficult locations with demanding visual stability and access. One typical example may be mesorectal dissection in narrow pelvis. The vision loss occurring at such level due to particles gathering on tip of the scope require scope removal and manual cleaning. Historically cleaning the scope on visceral or intra-abdominal organs or placed devices was proposed. The first proposal was abandoned as the scope tip may be heated up to 100°C and produce tissue damage.[11] The placement of intraperitoneal cleaning devices was abandoned due to maintaining problems and probably high cost.[12,13] Our study had relatively very low number loss of vision events when compared with literature.[2] This may be due to provided continuous $CO_2$ flow at the tip of the scope which restricts the required time for condensation and repels the smoke or evaporated tissue products. The saline wash further provides rapid cleaning of the tip for any gathered material as demonstrated in the video (see Video, Supplemental Digital Content 1, http://links.lww.com/SLE/A338). The decreased number of loss of vision is more than important as all described methods in literature have much higher number of events during surgery.

## CONCLUSION

In conclusion, reduced vision during colorectal surgery is a common problem and has several contributors. Although most of the traditional methods focus on scope heating and mechanical cleaning, current system provides continuous $CO_2$ flow at the front of scope and on demand activated saline flush, both maintaining clear vision. Fogging and tissue products may be kept away from the tip of the scope with the help of this new device. Our first experience demonstrated no need for scope removal with no device related complication. Larger comparative studies may differentiate the contribution of device to laparoscopic colorectal surgery and reduction in nonoperative surgery time.

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