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Review

Transforming laparoendoscopic surgical protocols during the COVID-19 pandemic; big data analytics, resource allocation and operational considerations

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ABSTRACT

The current dreadful pandemic of coronavirus disease (COVID-19) is playing havoc with humanity, socio-communal systems and economic reserves worldwide. Certain countries have managed to curtail COVID-19 crisis to some extent, however, a great majority still remains helpless in containing this outbreak. Rapidly evolving disease patterns and complex epidemiology of the COVID-19 necessitate a tailored approach by medical experts in dealing with this devastating outbreak. Similar to other medical disciplines, surgical associations and societies have developed a tailored approach of patients’ selection and management plans with improvised endolaparoscopic practice during the COVID-19 pandemic. Non-essential and non-urgent surgical procedures are deferred till this outbreak is abated. Benefits of delaying elective and non-urgent surgery outweighs the risk of performing surgical procedures on patients with asymptomatic or active COVID-19 disease. Laparoendoscopic procedures increase the risk of aerosol exposure, disease transmission and contamination. Limiting the number of operating room personnel, use of disposable instruments, small trocar incisions, negative pressure environment, and setting energy devices at low modes can help reduce disease transmission during laparoendoscopic procedures. This write up sheds lights on the impact of the COVID-19, big data analytics of response of medical personnel in understanding and curtailing the disease process and the consensus guidelines for carrying out laparoscoendoscopic procedures.

1. COVID-19 outbreak

A new type of coronavirus that originated from Wuhan, China, now spread to 180 other countries worldwide, is reposable for the current pandemic of coronavirus disease (COVID-19). As of May 2020, the World Health Organization (WHO has reported a total of 4,374, 889 COVID-19 cases with 294, 412 deaths, while 1,622,069 patients have successfully recovered from this potentially fatal disease [1]. The WHO has confirmed that, historically, COVID-19 spread to the humans via transmission from wild animals illegally sold in the Huanan Seafood Wholesale Market in Wuhan [2]. The phylogenetic analysis and taxonomy of the novel coronavirus has prompted the Coronavirus Study Group of the International Committee on Taxonomy of Viruses to recognize this virus as a sister to severe acute respiratory syndrome coronavirus (SARS-CoV-2) that belongs to the genus Betacoronavirus [3].

2. Analysis of global response to COVID-19 by novel research

As it stands, from January to May 2020, the ScienceDirect database has published approximately 6,202 documents about COVID-19 in medical and allied health sciences [4]. In the ScienceDirect repository, China has contributed by the largest number of publications, followed by the United States, Italy and United Kingdom (Fig. 1). To some extent, this trend of proliferation of scientific documents reciprocates with the magnitude of disease burden and associated morbidity and mortality in these countries.

A search in the Web of Science database has shown 1,542 documents about COVID-19 published during January to May 2020 in a wide spectrum of publishing titles (Fig. 2). As demonstrated in the Web of Science tree map, the British Medical Journal, Lancet and Journal of Medical Virology have published major bulk of literature about COVID-19 so far.

Further, breakdown of publications in medical disciplines in the Web of Science database has shown a highest number of documents

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Fig. 1. Illustration from the ScienceDirect database reflecting the growth of scientific research documents from different countries during 2020 (Literature search was conducted on 10th May 2020).

Fig. 2. The Web of Science tree map of published articles during 2020 about COVID-19 in different medical fields illustrating major publishing titles with respective number of publications (Literature search was conducted on 10th May 2020).

Fig. 3. The Web of Science tree map of the articles published during 2020 about COVID-19 in a range of medical disciplines with corresponding number of publications (Literature search was conducted on 10th May 2020).
published in the Journal of Internal Medicine, followed by Surgery, Imaging and Infectious Disease journals (Fig. 3). This includes all categories of articles such as editorial, review, original research, opinions, short communications, letters to editors and commentaries.

This data reflects enormous response by the medical fraternity to COVID-19 pandemic by conceiving, conducting and publishing novel research in a wealth of publishing titles. Regrettably, despite this profound work, so far we have neither succeeded in drawing a unified contingency management protocol nor a vaccine for combating COVID-19 disease.

3. Epidemiology of COVID-19

Generally, almost all age groups are susceptible to COVID-19 as approximately 86.6% of all patients, infected so far, were aged between 30 and 79 years with a median age of 47 years [5]. Though literature has not reported significant gender preponderance, men are shown to exhibit a higher propensity for COVID-19 [6]. The major mode of transmission of SARS-CoV-2 is human-to-human and, according to the National Health Commission of China, SARS-CoV-2 spreads through respiratory aspirates, droplets, direct exposure, feces, and aerosols transmission [7]. There are sporadic reports about vertical transmission of SARS-CoV-2 but literature does not provide concrete evidence about this mode of spread [8,9]. On the same note, Chen et al. did not find SARS-CoV-2 from the amniotic fluid, cord blood, neonatal throat swab, and breast milk samples of pregnant women infected with COVID-19 in their third trimesters [10]. Recent research has shown that cough and sneezes contain mucosalivary droplets that result from short-range semi-ballistic emission trajectories [11]. These droplets are primarily composed of a complex cloud that embrases air, cluster of droplets and pathogens. Due to the forward thrust of this cloud, the virus-containing droplets are propelled much farther than if they were thrown without a heavy cloud. This biophysics of gas clouds and gas cloud dynamics bears significant implications in disease progression and provides the basis for a mandatory 2-m social distancing and home-isolation. Though researchers have reported growth of SARS-CoV-2 RNA from blood and feces of COVID-19 patients (2, 3), Coccolini et al. have confirmed its presence in the peritoneal cavity of a 78-year-old man [12]. Using the real-time reverse transcriptase-polymerase chain reaction (RT-PCR), the investigators have detected the genome of SARS-CoV-2 RNA in the peritoneal fluid. This finding has significant implications for the abdominal surgeons and gastroenterologists as they invariably deal with GIT fluids and secretions during their clinical practices.

Parallel with the evolving guidelines for combating COVID-19 outbreak in medical field, several international surgical societies and regulatory bodies have developed a wealth of surgical protocols. These recommendations primarily aim to safeguard the surgical patients, the surgeons and their surgical teams from adverse and fatal outcomes of COVID-19. The following sections of this article provide major modifications in laparoscopic surgical practice for elective and emergency surgical procedures during the COVID-19 pandemic.

4. Protocols for elective and cancer surgeries

Similar to other medical fields, COVID-19 pandemic has substantially influenced the workplace policies and procedures in surgical disciplines. From a global perspective, the federal governments and health-care authorities have modified the protocols and guidelines for general and specialty surgical practices [13]. Elective surgery for benign disorders are deferred till COVID-19 pandemic is abated. This is mostly driven by the fact that laparoscopic surgery for benign and non-urgent illnesses may potentially lead to unwanted complications with poor surgical outcomes [14]. Healthcare professionals (HCPs) should inform the patients and their families about medical reasons for postponing elective surgery, particularly for collective community welfare of reserving hospital beds for critically ill patients with respiratory disorders. On the other hand, oncological surgery would continue during the COVID-19 crisis by adhering to general principles of surgical practice [15,16]. Delay in surgery for cancer patients will not only worsen the prognosis [17], but also the estimated risk of surgical complications and morbidity and mortality would increase [18,19]. Careful selection of the patients and adherence to the revised and modified surgical principles during the COVID-19 outbreak are essential.

5. Operating room protocols for all surgical procedures

a. Operating theatres should have a negative pressure flow below 4.7 Pa to prevent outward diffusion and contamination of personnel and external surfaces.

b. Operating teams should have appropriate personal protection equipment (PPE) including face shields, gloves, masks, gowns and caps.

c. Separate contingency plans should be in place for operating theaters about entry-points of the patients with COVID-19 (symptomatic), suspected of COVID-19 (asymptomatic carriers) and for COVID-19 free (non-infected) patients [20].

d. All patients planned for endoscopic or surgical procedure must undergo a comprehensive pre-operative health screening protocol despite being asymptomatic.

e. For patients with life-threatening conditions where results of RT-PCR are not available, consider them as infected and manage them with the protocol for infected cases [21].

f. Aerosol generating procedures (AGPs) such as intubation, extubation, bag masking, bronchoscopy, chest tube insertion, upper and lower GIT endoscopy, laparoscopy and electrocautery lead to a high risk of aerosol exposure of HCPs [22]. Special precautions should be observed and strictly followed during all AGPs.

g. During AGPs, adjust devices to the lowest effective power settings in order to reduce the amount of surgical smoke emitting from operating areas.

h. During all endolaparoscopic surgeries, limit the number of HCPs in operating rooms and instruct them to leave room during AGPs and particularly during intubation and extubation processes.

i. Separately clean all surgical equipment that was used during surgical procedures in with COVID-19 positive patients or persons under investigation (suspected COVID cases).

6. Protocols for laparoscopic surgery procedures

Laparoscopic surgery should be offered cautiously as the risk of exposure and contamination of personnel is high. There is an estimated risk of exposure of HCPs to SARS-CoV-2 due to its presence in the peritoneal cavity. The energy devices used during surgery and endoscopy such as electrocautery or ultrasonic shears produce surgical smoke (plume) during tissue dissection. Aerosolization of plume during endolaparoscopy is the most crucial deterrent to the use of laparoscopic surgery during COVID-19 outbreak [23]. The aerosol effect during surgery serves as potential leaks from trocars and post-surgery (exsufflation) can contaminate HCPs and surrounding surfaces by airborne transmission.

On 30.03.2020, the Society of American Gastrointestinal and Endoscopic Surgeons (SAGES) and the European Association of Endoscopic Surgeons (EAES) have provided guidelines for the surgical response to the COVID-19 outbreak [24]. A summary of the guidelines are provided hereunder;

a. Though there is inconclusive evidence about relative risks of laparoscopic surgery as compared to conventional surgery during the COVID-19 era, potential contamination of operating theatres, HCPs, and surroundings is possible. Therefore, strict protective measures
including the use of PPE should be in place during peri-operative period.

b. All laparoscopic procedures should be performed for life-threatening conditions only. Surgeons must ensure that all trocars are carefully introduced through abdominal opening without leakage and, preferably, by using balloon trocars.

c. Use disposable trocars and endoscopic instruments as cleaning the useable equipment adds risk of contamination.

d. Surgeons should use aspirators to remove smoke and to avoid leakage of smoke through trocars.

e. Maintain pneumoperitoneum at a lower pressure of 10–12 mm of Hg and low flow rate of insufflation.

f. Perform exsufflation and deflation of the peritoneum before removing trocars and specimen.

g. Due to the presence of SARS-CoV-2 virus in saliva, GIT secretions, stool and blood, operators should set up energy devices at minimal level during all laparoendoscopic procedures.

h. Discourage long dissection time at same point by laparoendoscopic approach.

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The European Society of Gastrointestinal Endoscopy (ESGE) and the European Society of Gastroenterology and Endoscopy Nurses and Associates (ESGENA) have jointly provided a position statement [25] with the following salient features;

a. COVID-19 can be effectively eradicated by the commonly used disinfectants with virucidal activity.

b. Gastroenterologists should not reuse disposable GI endoscopic devices.

c. All HCPs and patients in the GI endoscopy unit should wear respiratory protective equipment.

d. Standard PPE should include gloves, hairnet, goggles or face shield, waterproof gowns, booties/shoe covers, and respiratory protective equipment.

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e. In terms of risk stratification, GI endoscopy should always be performed for; upper and lower GI bleeding and anemia with hemo-
dynamic instability, foreign body in esophagus, acute ascending cholangitis and obstructive jaundice and capsule endoscopy for torrential bleeding.

f. Low priority endoscopic procedures should be offered for conditions such as low grade GI dysplasia, duodenal polyp, ampullectomy, achalasia and biliary strictures.

g. A case-by-case review and individualized decision is recommended.

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Data statement

I declare that there is no conflicting or fabricated data in this research. The entire data in this research has been taken from Web of Science and ScienceDirect databases.

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This is a review article and my institution does not require ethical approval for such type of research.

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Author contribution

SYG conceived the research concept, conducted initial and final search for literature review, and wrote the final draft. SYG is responsible for the originality of this research article.

Registration Unique Identifying number (UIN)

Not applicable as this is not a human study and covers review of the literature.

Name of the registry:

1. Unique Identifying number or registration ID:

1. Hyperlink to your specific registration (must be publicly accessible and will be checked):

Guarantor

Prof. Salman Guraya is responsible for the work and provides full guarantee for the academic integrity and originality of this work.

Declaration of competing interest

No conflict of interests declared.

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