An Innovative Design of Siriraj Collapsible Paper Box Set for Electroconvulsive Therapy in Psychiatric Patients during COVID-19 Outbreak

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As a result of the Coronavirus disease-2019 pandemic, there have been strict screening measures for patients scheduled for operations or procedures that require anesthesia. Personal protective equipment is essential to narrow the chance of transmission of the virus to medical personnel. Other protective barriers which reduce direct viral transmission to the atmosphere can potentially limit the infection rate. This article discusses about the innovation called "Siriraj collapsible paper box set". The box is supposed to cover the patients during Electroconvulsive therapy to diminish the spreading of droplets or aerosols during anesthesia.

Keywords: Coronavirus disease-2019 (COVID-19), Electroconvulsive therapy, Non-operating room anesthesia, Patient under investigation (PUI), Personal protective equipment (PPE)

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Background

According to the global outbreak of Coronavirus disease-2019 (COVID-19), World Health Organization (WHO) currently issues daily report on the total number of infected patients. Over 2.7 million cases have been detected from the beginning of the outbreak to nearly the end of April 2020 with over 180 thousand deaths. In Southeast Asia region, greater than 40 thousand of emerging cases are reported with the death rate accumulates to the total of 1.7 thousand cases. Overall infected cases in Thailand as of April 27th have amounted to 2,931 where there are 52 reported deaths or 1.8% of total infected patients. Issued policies from the Ministry of Public Health in pursuance of disease spreading control comprise health education on prevention and control of COVID-19 spreading with an emphasis on personal hygiene, early detection and separation of the infected and high-risk cases and encouragement of social distancing by working from home, having flexible working hours or promoting online business and transactions.

Albeit a tendency toward a decline in new infection rate, the entire amount of COVID-19 positive cases and the cases under treatment is still immense. Moreover, there also are populations with risk of infection yet have not been investigated (Patient under investigation; PUI). Thus, prudent screening and prevention of viral transmission are still considered paramount measures for hospitals and other healthcare service units. Recent study reveals that COVID-19 transmission is achieved through inhalation of droplets from infected patients within the distance of 6 feet or by direct contact with the patients' mucous membrane. No reliable evidence is reported on the viral transmission through contact with the surface of contaminated objects. However, direct contact with such surface may result in self-inoculation or transmission to other persons.[2]

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Viral transmission during anesthetic procedures

Viral transmission can occur during anesthetic procedures in the operating theaters owing to contamination of anesthesia working station and equipment with droplets which, in turn, create reservoirs for further transmission. According to the facts that the incubation time of COVID-19 is approximately 5 days or longer and some of the infected individuals may be asymptomatic or present with only slight symptoms, there is still a decent number of patients who are under suspicion. Issued guidelines suggested medical personnel use surgical masks and N95 for droplet and aerosol prevention, respectively.[3] Risk of droplet and aerosol transmission is when anesthesiologists perform bag mask ventilation, endotracheal intubation or procedures concerning oral cavities and gastrointestinal (GI) tracts or respiratory tracts.

Non-operating room anesthesia (NORA): electroconvulsive therapy

With regard to anesthesia service outside the operating room (Non-operating room anesthesia, NORA), for example, GI endoscopic procedures, intervention radiology and electroconvulsive therapy (ECT), the working atmosphere is different because of the deficiency of hepa filter system and certain anesthetic equipment. Despite strict screening of NORA patients, who mostly visit the hospitals as ambulatory cases, to isolate the patients at risk of infection, some cases with obscured histories may proceed to operation. Several hospitals and centers for Medicare and Medicaid services in the USA have suspended or restricted ECT procedures during the COVID-19 outbreak to preserve medical resources and reduce viral spreading. Anyhow, ECT is considered lifesaving procedure for the reason that it is an ultimate treatment for patients with suicidal ideation, severe depression or treatment-resistant conditions. Additionally, the patients suffering from severe depression in the presence of psychosis are at high risk of suicide if not treated promptly and effectively.[4] Acute ECT course is an initial treatment series for patients with acute symptoms. Subsequently, continuous ECT (C-ECT) is programmed to prevent of relapse of psychotic episodes. Maintenance ECT (M-ECT) is the treatment after C-ECT designed to avoid recurrence of new episodes. Discontinuation of acute ECT course during COVID-19 pandemic in recurrent depression case who was previously responsive to ECT resulted in suicidal attempt.[5] Failure to complete M-ECT course may accordingly result in reappearance of psychotic events. Experienced psychiatrist also suggested that ECT could not be an elective procedure.[6]

Electroconvulsive therapy (ECT) procedure in Siriraj Hospital

Regarding the collected statistics on ECT service of the Department of Psychiatry, Faculty of Medicine, Siriraj Hospital, 575 procedures were performed under general anesthesia throughout 2018. Briefly, the patients are initially preoxygenated with 100% oxygen before being intravenously administered with sedative agent and muscle relaxant, succinylcholine. Bite blocks are subsequently inserted to prevent orodental trauma. Then, the psychiatrist is in charge of applying electrical current to induce seizure (Figure 1). If adequate seizure is achieved, the procedure is completed. The important roles of anesthesiologist are maintenance of airway patency, assisting ventilation, if necessary, until the patient resumes spontaneous breathing and stabilization of the hemodynamics before patient transfer to the recovery area. There are several precarious steps during ECT procedure which may allow droplet transmission to the atmosphere such as preoxygenation and bite block insertion. Aerosol can as well contaminate the atmosphere during bag mask ventilation in case there are situations which assistance of ventilation is required, for example, airway obstruction, delayed spontaneous ventilation and oxygen desaturation. It is vigilant to use full PPE during airway manipulation, however, anesthesia providers do not routinely use PPE owing to limited resource. Despite a strict patient screening before ECT procedure, amid the outbreak of COVID-19, it is prerequisite that medical personnel

properly protect themselves against infection by wearing disposable plastic aprons with sleeves, surgical or N95 masks, face shields and gloves. Restricted staff anesthesia selection from the staff pool for ECT service is encouraged to diminish cross contamination to other medical personnel. Disposable bite blocks and face masks are changed for each batch of patients.

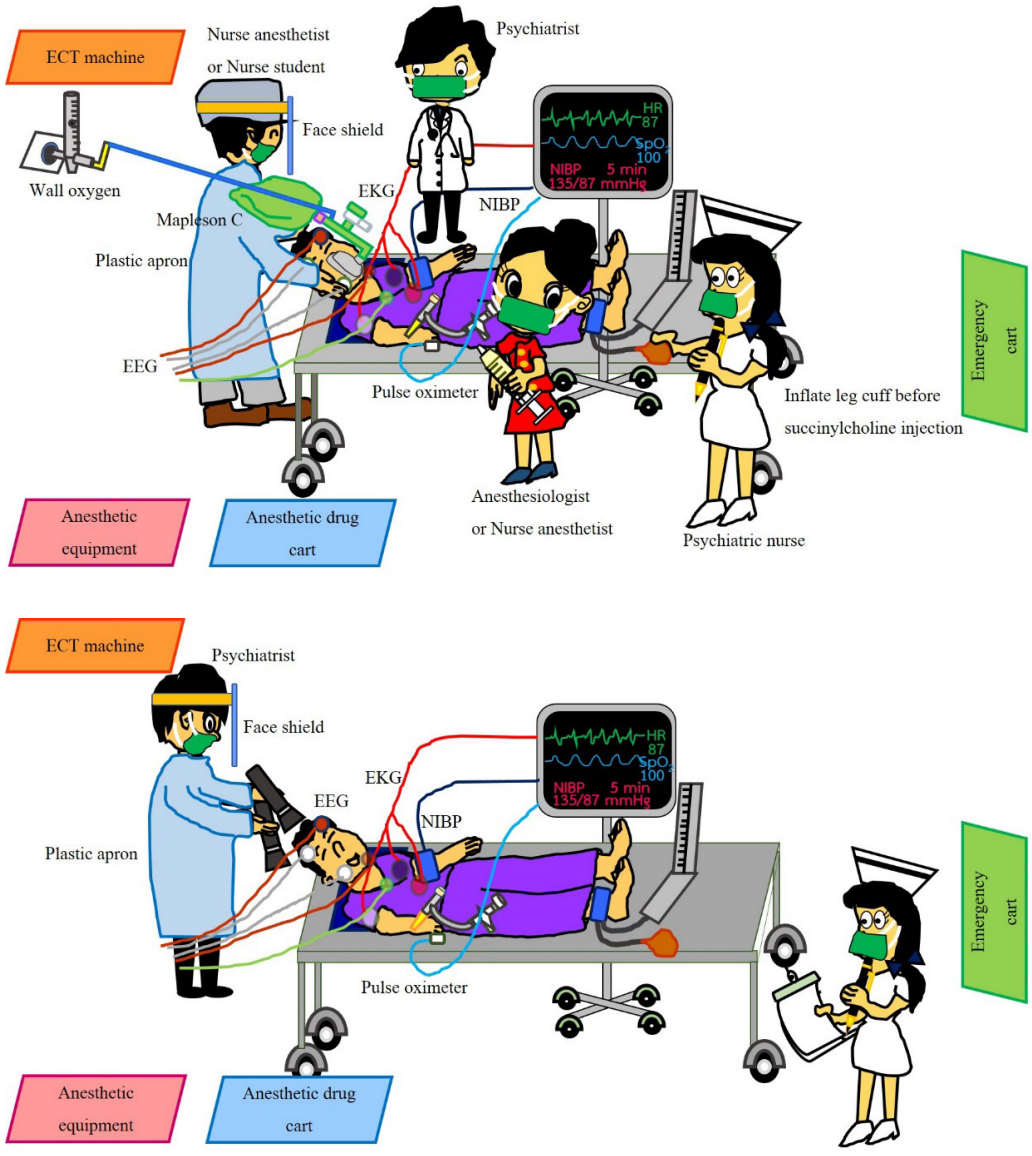

Figure 1 Electroconvulsive therapy procedure. (Illustrated by Pawit Somnuke)
(Top) The patient is preoxygenated with 100% oxygen before being administered with sedative drug. After eyelash reflex loss, the blood pressure (BP) cuff at the leg is inflated prior to succinylcholine administration to prevent the distribution of the drug to the area below BP cuff.
(Bottom) When the patient is fully relaxed, bite blocks are inserted. The psychiatrist then applies electrical current to induce seizure.
ECT = Electroconvulsive therapy, EKG = Electrocardiogram, EEG = Electroencephalogram, NIBP = Non-invasive blood pressure)

An innovative design of Siriraj collapsible paper box set for ECT

Previous study compared the degree of droplet contamination after extubation between acrylic box and plastic sheet covering and found that despite higher cost and difficulty in cleaning, the box was easier to use due to its rigid structure. The advantages of the plastic sheet were less contamination to the manikin underneath the sheet, convenience of disposure and lower cost. However, it exhibited self-contamination towards the extubator. The author suggested that with tightly sealed plastic coverage around the box and avoidance of frequent exposure to the atmosphere, the box could be considered as closed system and hence reduce the chance of contamination.[7] The aim to prevent infection has led to the design of "Siriraj collapsible box set for ECT" to limit the spread of droplets and aerosols during ECT procedure. This single-use box is made of cardboard paper which offers many advantages including being light weight, environmental-friendly and easily collapsed after use for further destroy. The benefit of single-use box is it does not require disinfection after use thus reducing the risk of infection to the cleaning staff. Studies demonstrate that aerosols containing COVID-19 can thrive in the air for as long as 3 hours.[8] Notably, the virus can survive up to days on the surface of different materials. COVID-19 is stable on paper for up to 24 hours whereas on other surfaces like stainless steel and plastic, the viable virus can be detected for up to 48 and 72-96 hours, respectively.[9-10] Accordingly, it is safe to say that another benefit of Siriraj collapsible box set for ECT is that it has lower risk of being virus reservoir than the plastic one.

To perform ECT, amnesia and muscle relaxation should be induced. The optimal agents for ECT should have short half-life and rapid recovery with least effect on seizure threshold and duration. The patient scheduled for ECT is transferred to the ECT room then the vital signs are monitored. After a brief explanation to the patient, the box is placed over the patient's head, neck and upper chest region (Figure 2). Plastic sheet or wrap is placed over the spaces of the box to minimize the contamination to the atmosphere outside. Then preoxygenation is initiated by using Mapleson C circuit (Figure 3) followed by intravenous sedation then electrical current administration as mentioned above. Recommended doses of frequently used sedatives are Thiopental 2-4 mg/kg or Propofol 1-2 mg/kg.[10-11] Average dose of succinylcholine for successful muscle relaxation in ECT is reported to be 0.9 mg/kg.[12] Suction tube is placed inside the box to create negative pressure throughout the procedure. Based on direct observation of approximately 40 cases from the beginning of the outbreak in Thailand to the end of April 2020, adequate preoxygenation can diminish the risk of oxygen desaturation and the need to assist ventilation. The box is easily lifted off from the patient and collapsed into infectious waste container for a safe destroy. At present, medical personnel from the Departments of Anesthesiology and Psychiatry express satisfaction towards the use of Siriraj ECT box because of its convenience, user-friendly design and safety. Ongoing work is focusing on the development of design and practicality to achieve the most suitable version that can be used not only for ECT but for other procedures both inside and outside the operating rooms.

In summary, the novel protective box for ECT is invented in lieu of regular ECT practice without protective barrier which contamination by the patient's secretion may be plausible. This idea may be applied to other cases besides COVID-risk patients i.e. patients with upper respiratory tract symptoms by other causes or patients at risk for Tuberculosis. Nevertheless, personal hand hygiene, proper PPE and avoidance of social gathering are still regarded as effective measures that everyone has to comply.

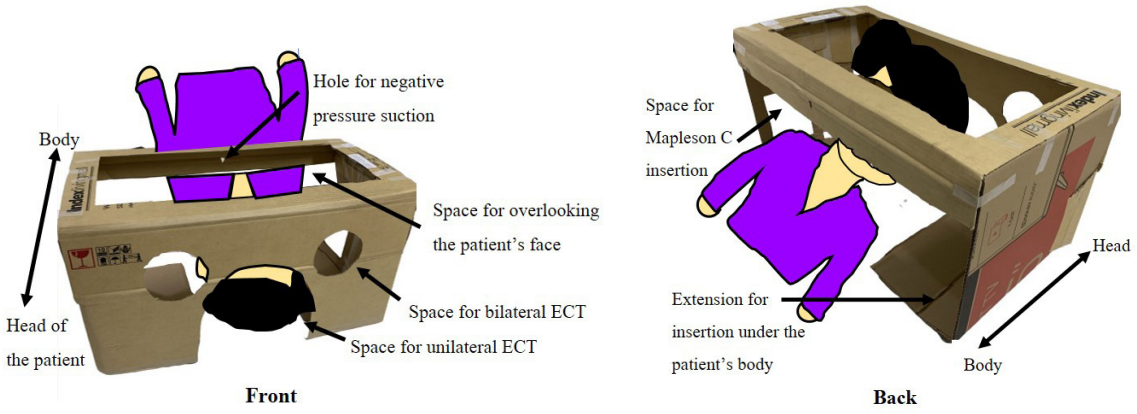

Figure 2 Siriraj collapsible paper box set for ECT. (Designed and illustrated by Pawit Somnuke) The box is placed over the patient's head and upper body before the ECT procedure.
(Left) Front side of the box. Arrows indicate a hole for insertion of suction tube to create negative pressure, 2 circular spaces for bilateral ECT, a semicircular space in midline for unilateral ECT and space on top of the box to look at the patient during the procedure. The spaces require transparent plastic cover before use.
(Right) Back side of the box. Arrows indicate the extension under the patient's body to immobilize the box during the procedure and the side space for Mapleson C circuit. The side of the box requires transparent plastic cover before use.

Figure 3 Mapleson C circuit. Two HME filters are placed to the circuit as one filter is connected to the face mask while the other is connected to suction tube to absorb the patient's expiratory breaths.

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