Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Editorial

COVID-19 pandemic: A multifaceted challenge for science and healthcare

The last days of December 2019 marked an historical event in recent history, with the outbreak of the coronavirus infection in Wuhan, China and the declaration of a pandemic by the World Health Organization on March 11, 2020 [1].

The SARS-CoV-2 became an overwhelming challenge to health care systems worldwide, due to easy and fast infection, as marked by the virus reproduction time and the severity of illness resulting especially in frailer individuals [2]. Suddenly severe pulmonary and systemic complications [3] were seen, with all the implications for healthcare professionals protection and infection risks [4,5], the choice of best personal protective equipment (PPE) [6,7] and issues related to PPE shortage, correct use and training [8]. The debate on airborne transmission [9] and operational limitations because of the pandemic challenged healthcare systems that already faced a surge of critically ill patients, which immediately appeared to be beyond the system capacity [2]. Society beyond health care systems were confronted with implications on ethics [10], on professionalism, on ongoing medical training [11], on healthcare providers' burnout and stress [12], on "avoidable deaths", and on a global crisis on needed resources, supplies, devices, PPE, and human workforces.

1. The COVID-19 challenge and the quality of research

With the new disease, a sudden unprecedented worldwide cooperation of researchers led to open-access of interdisciplinary and international data sharing, which revealed fast sequencing of virus genome and diffusion of clinical experience. Travel restrictions and cancellations of face-to-face meetings triggered a large series of virtual meetings to share experience of whom was fighting the pandemic with those who were expecting to start their battles. Sometimes the "scientific hurry" resulted in misleading studies, in poorly-sustained researches, igniting confusion, fear and, probably medical errors [13,14].

However, this evolving framework of understanding the underlying COVID-19 pathophysiology started as pure devastating pneumonia, with atypical pattern and the specific and unique clinical picture of "silent hypoxia" [15]. It was understood that SARS-CoV-2 did not lead to a "single" pneumonia, rather different phenotypes requiring different approaches were proposed based on different risk factors and co-existing diseases [3]. The choice of alveolar recruitment, selection of best PEEP, and prone positioning of patients was controversial in the early phases of the pandemic but reconsidered the more we understood of the disease.

In this issue of TACC, Fernandez-Sarmmiento and Colleagues [16] present a comprehensive review of SARS-CoV-2 infection, analyzing epidemiology, pathophysiology, clinical scenario and management options, with special emphasis on a checklist and protocol for airway management and a comprehensive overview on mechanical ventilation and respiratory support options. Alves Bersot and the Brazilian group [17] discuss also in this issue the physiology of prone positioning and the use of this approach for COVID-19 pneumonia. The authors propose interesting suggestions for focused and planned pronation cycles i.e. after urgent surgery in COVID-19 critical patients. In the same perspective, Song and Colleagues [18] underline the importance of preparing adequate critical care resources, concentrating on critically ill patients in predesignated hospitals and triaging. This paper also discusses the role of cytokine storm and they propose an elegant algorithm for respiratory support, including Extracorporeal Membrane Oxygenation (ECMO), for severe COVID-19 patients.

Frazer and Colleagues [19] discuss in their a review-style approach coagulation disorders in COVID-19 patients, unveiling a "missing" piece of the puzzle, which was completely underestimated or misunderstood in the initial phases of pandemic and which probably contributed to change the therapeutic approach, with implications on outcome, at the later stage. The issue is largely debated and partly still unclear but out of any doubt it represents one of the most important pathophysiological and therapeutic mechanism in the frame of severe SARs-CoV2 infection [20].

2. The MacGyver effect: using better what we have and invent what we don't

The overwhelming request of qualified personnel, respirators, medical resource, PPEs and critical care beds deeply influenced the "routine" concept of critical care and patients' triaging during the pandemic which unveiled the fragility of the health care system, and the fragility of the exhausted personnel as human beings. A crucial priority was and is proper and available PPE [21,22]. People started to invent their own 3D printed PPEs [23] or reused them [24,25]. If such approaches make sense the need to be assessed by rigorous and methodologically correct research. It is understandable that during the emergency solution were found but its validity, efficacy and benefit still needs to be scientifically addressed.

COVID-19 forced the critical care personnel for safe airway management strategies [2,26–30] by changing the paradigm. Health care workers' safety before medical needed interventions, like airway management, given the risk of infection during aerosol generation procedures. Simulation as an educational tool to handle such situations was proposed earlier [31]. In this issue of TACC, Ansari and Colleagues [32] provide the reader with an elegant in-situ simulation study exploring the effect of PPE on airway management, recalling the need for dedicated procedures, teamwork and

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training. With these premises, and as a response to PPE shortage, aerosol boxes, plastic covers and many other original artifacts were introduced in the clinical practice, with fast diffusion of their use but unparalleled proof of their efficacy. That created emerging concerns for their real effectiveness and the risk of such barrier device in airway management [33] and of "secondary aerosolization" upon removal [34]. With these in mind, we recommend reading the interesting reports by Kumar and Colleagues in this issue of TACC [35,36]. The Authors describe and discuss a low-cost and effective humidification/filtration assembly to be used in the operating room, an elegant solution for an incentive spirometry and an interesting low-cost apparatus to provide non-invasive ventilation in COVID-19 patients using a negative pressure isolation bed system. These initiatives are to be applauded and encouraged, but promoting parallel high-profile scientific research to validate the new devices, to avoid the risks of false safety or unexpected side effects, despite the brilliant *MacGyver approach* [37].

We probably need to revise our knowledge and to rely on and use better what we have: this is the message from the study by Chekol and Colleagues [38], offering useful information and checklists for adequate preparation for elective or emergent surgical care of COVID-19 patients, including well-proven techniques and devices and proposals of "emergency situation" solutions. Approaches for safe airway management [39], and how to organize dedicated airway teams during the pandemic were also described earlier [40].

Similar examples of "adapting" well-known techniques using ultrasound. Ultrasound machines are easy to transport, they can work bedside, they are easy to clean and many anaesthesiologists and critical care physicians are familiar with the important role for lung evaluation and decision making [41]. Extended protocols have been proposed for a holistic approach of COVID-19 patients [42]. In this issue of TACC, Dixit and Colleagues [43] propose a revised US-based protocol for central venous catheterization, combining the well-recognized benefits of US for this application with requested protocols and behaviors to grant operator's safety and reducing cross-infection risks.

3. Still a lot to understand

COVID-19 and the SARS-CoV-2 are still partly unknown, but rigorous research and clinical experience will reveal the best approach to treat our patients [44] A better understanding of the disease's pathophysiology and mechanism of systemic injury is needed to understand the entire "syndrome"[3]. The involvement of the immune system [45] and the best therapeutic approach needs also to be evaluated as many manifestations of COVID-19 were described, including neurological [46] or cardiological [47] symptoms, cutaneous localization [48], and limb ischemia [49]. In this issue of TACC, Leopard and Colleagues [50] describe atypical vocal cords complications, highlighting the specific tropism of SARS-CoV-2 for upper and lower airway mucosa. Severely symptomatic patients exhibit a viral load up to 60 times the mild ones [51,52], with implications on airway mucosal inflammation and higher risk of airway lesions, including a seemingly higher incidence of bougie-related trauma [53], of pneumothorax and pneumomediastinum [54] and thoracic complications [55].

4. The next future

COVID-19 pandemic is an unprecedented event in the recent history of modern medicine. It still represents a worldwide challenge affecting any aspect of our daily life and the way we practice medicine. Implications and consequences on the different healthcare systems, on medical practice and scientific research are unique, multiple and probably partly unexplored. The pandemic ignited a paradox: while imposing social distances and isolation, it succeeded to put together researchers and physicians from all around the world independently of races, religion, geography and politics. This worldwide cooperation has led to a prompt and fast response at every level, with production of a huge body of research and daily proposals of novel techniques, devices and therapeutic approaches, which are spread worldwide on the wings of social media and scientific journals. This is probably the very important lesson we should learn from SARS-CoV-2: through challenging times, proper science, good sense of the doable and teamwork remain one of the most powerful tools also against a merciless and insidious enemy.

References

[1] C. Wang, P.W. Horby, F.G. Hayden, G.F. Gao, A novel coronavirus outbreak of global health concern, Lancet 395 (2020) 470–473.

[2] M. Sorbello, K. El-Boghdadly, I. Di Giacinto, et al., The Italian coronavirus disease 2019 outbreak: recommendations from clinical practice, Anaesthesia 75 (2020) 724–732.

[3] C. Robba, D. Battaglini, P. Pelosi, P.R.M. Rocco, Multiple organ dysfunction in SARS-CoV-2: MODS-CoV-2, Expet Rev. Respir. Med. (2020) 1–4, https://doi.org/10.1080/17476348.2020.1778470.

[4] https://www.worldometers.info/coronavirus/#countries accessed august, 2020.

[5] K. El-Boghdadly, D.J.N. Wong, C. Johnstone, I. Ahmad, intubateCOVID collaborators, Tracheal intubation of patients with COVID-19: global risks, Anaesthesia (2020), https://doi.org/10.1111/anae.15205.

[6] S.L. Lockhart, L.V. Duggan, R.S. Wax, S. Saad, H.P. Grocott, Personal protective equipment (PPE) for both anesthesiologists and other airway managers: principles and practice during the COVID-19 pandemic. Équipements de protection individuelle (EPI) pour anesthésiologistes et autre personnel en charge des voies aériennes: principes et pratiques pendant la pandémie de COVID-19, Can. J. Anaesth. 67 (2020) 1005–1015, https://doi.org/10.1007/s12630-020-01673-w.

[7] J. Schumacher, J. Arlidge, D. Dudley, M. Sicinski, I. Ahmad, The impact of respiratory protective equipment on difficult airway management: a randomised, crossover, simulation study, Anaesthesia (2020), https://doi.org/10.1111/anae.15102.

[8] M. Sorbello, K. El-Boghdadly, J. Schumacher, I. Ahmad, Personal protective equipment, airway management, and systematic reviews. Comment on Br J Anaesth, Br. J. Anaesth. 2020 (2020), https://doi.org/10.1016/j.bja.2020.06.038. S0007-0912(20)30498-0.

[9] L. Morawska, D.K. Milton, It is time to address airborne transmission of COVID-19, Clin. Infect. Dis. (2020), https://doi.org/10.1093/cid/ciaa939 ciaa939.

[10] N. Zareifopoulos, M. Lagadinou, A. Karela, G. Karantzogiannis, D. Velissaris, Intubation and mechanical ventilation of patients with COVID-19: what should we tell them? Monaldi Arch. Chest Dis. 90 (1) (2020) https://doi.org/10.4081/monaldi.2020.1296.22.

[11] P.D. Megaloikonomos, M. Thaler, V.G. Igoumenou, et al., Impact of the COVID-19 pandemic on orthopaedic and trauma surgery training in Europe, Int. Orthop. (2020) 1–9, https://doi.org/10.1007/s00264-020-04742-3.

[12] F. Urdaneta, M. Stacey, M. Sorbello, The adverse impact of COVID-19 on healthcare providers: time to start measuring, Anesth. Analg. (2020), https://doi.org/10.1213/ANE.0000000000005088.

[13] L. Peyrin-Biroulet, Will the quality of research remain the same during the COVID-19 pandemic? Clin. Gastroenterol. Hepatol. 18 (2020) 2142, https://doi.org/10.1016/j.cgh.2020.03.054.

[14] F.S. Taccone, J. Gorham, J.L. Vincent, Hydroxychloroquine in the management of critically ill patients with COVID-19: the need for an evidence base, Lancet Respir Med. 8 (2020) 539–541, https://doi.org/10.1016/S2213-2600(20)30172-7.

[15] W. Ottestad, S. Søvik, COVID-19 patients with respiratory failure: what can we learn from aviation medicine? Br. J. Anaesth. (2020) https://doi.org/10.1016/j.bja.2020.04.012.

[16] J. Fernandez-Sarmiento, et al., Severe SARS-CoV-2 infection in critical care, Trends Anaesth. Crit. Care 34 (2020) 28–37, https://doi.org/10.1016/j.tacc.2020.07.002.

[17] C.D. Alves Bersot, et al., Is the prone position indicated in critically ill patients with SARS-CoV-2 during the peri-operative period? Trends Anaesth. Crit. Care 34 (2020) 38–41, https://doi.org/10.1016/j.tacc.2020.06.006.

[18] X. Song, et al., Concerns about intensive therapies for critically ill COVID-19: summary of a panel discussion by global intensivists, Trends Anaesth. Crit. Care 34 (2020) 44–46, https://doi.org/10.1016/j.tacc.2020.06.002.

[19] J.S. Frazer, A.J. Tyrynis Everden, Emerging patterns of hypercoagulability associated with critical COVID-19: a review, Trends Anaesth. Crit. Care 34 (2020) 4–13, https://doi.org/10.1016/j.tacc.2020.07.004.

[20] S. Kaur, R. Bansal, S. Kollimuttathuillam, et al., The looming storm: blood and cytokines in COVID-19, Blood Rev. (2020) 100743, https://doi.org/10.1016/

j.blre.2020.100743.
[21] Ip V, Özelsel T, Sondekoppam R, Tsui B. COVID-19 pandemic. Greater protection for healthcare providers in the hospital 'hot zones'? Anesth. Analg., 2020 - doi: 10.1213/ANE.0000000000004880 [epub Ahead of Print]
[22] M. Sorbello, G. Morello, S. Pintaudi, R. Cataldo, COVID-19: intubation kit, intubation team or intubation spots? Anesth. Analg. (2020) https://doi.org/10.1213/ANE.0000000000004970.
[23] P.R. Armijo, N.W. Markin, S. Nguyen, et al., 3D printing of face shields to meet the immediate need for PPE in an anesthesiology department during the COVID-19 pandemic], Am. J. Infect. Contr. (2020), https://doi.org/10.1016/j.ajic.2020.07.037. S0196–6553(20)30762-30768.
[24] R.E. Harskamp, B. van Straten, J. Bouman, et al., Reprocessing filtering facepiece respirators in primary care using medical autoclave: prospective, bench-to-bedside, single-centre study, BMJ Open 10 (8) (2020), e039454, https://doi.org/10.1136/bmjopen-2020-039454.
[25] M.P. Czubryt, T. Stecy, E. Popke, et al., N95 mask reuse in a major urban hospital - COVID-19 response process and procedure, J. Hosp. Infect. S0195–6701 (20) (2020), https://doi.org/10.1016/j.jhin.2020.07.035, 30366-2.
[26] T.M. Cook, K. El-Boghdadly, B. McGuire, A.F. McNarry, A. Patel, A. Higgs, Consensus Guidelines for Managing the Airway in Patients with COVID-19: Guidelines from the Difficult Airway Society, the Association of Anaesthetists the Intensive Care Society, the Faculty of Intensive Care Medicine and the Royal College of Anaesthetists. Anaesthesia, 2020, https://doi.org/10.1111/anae.15054.
[27] D.J. Brewster, N. Chrimes, T.B. Do, et al., Consensus statement: safe Airway Society principles of airway management and tracheal intubation specific to the COVID-19 adult patient group, Med. J. Aust. 212 (10) (2020) 472–481, https://doi.org/10.5694/mja2.50598.
[28] M.Z. Zuo, Y.G. Huang, W.H. Ma, et al., Expert recommendations for tracheal intubation in critically ill patients with novel coronavirus disease 2019, Chin. Med. Sci. J. (2020), https://doi.org/10.24920/003724.
[29] B.A. Orser, Recommendations for endotracheal intubation of COVID-19 patients, Anesth. Analg. 130 (5) (2020) 1109–1110.
[30] W. Yao, T. Wang, B. Jiang, et al., Emergency tracheal intubation in 202 patients with COVID-19 in Wuhan, China: lessons learnt and international expert recommendations, Br. J. Anaesth. 125 (1) (2020) e28–e37, https://doi.org/10.1016/j.bja.2020.03.026.
[31] Tewfik George, Steven Shulman, Thomas Bachmann, The use of simulation to prepare for changes in emergent airway management in the early days of the Covid-19 outbreak, TACC 33 (2020) 23–24.
[32] U. Ansari, et al., The effects of personal protective equipment on airway management: an in-situ simulation, Trends Anaesth. Crit. Care 34 (2020) 23–27, https://doi.org/10.1016/j.tacc.2020.07.003.
[33] Johnny-wei Bai, Ananth Ravi, Lowyl Notario, Mabel Choi, Opening the discussion on a closed intubation box, TACC 33 (2020) 1–4.
[34] M. Sorbello, W. Rosenblatt, R. Hofmeyr, R. Greif, F. Urdaneta, Opening Pandora's Box: aerosol boxes and barrier enclosures for airway management in COVID-19 patients – a scoping review and narrative synthesis, Br. J. Anaesth. (2020). In press.
[35] N. Kumar, et al., Lessons from clinical practice during COVID-19 pandemic, Trends Anaesth. Crit. Care 34 (2020) 61–62, https://doi.org/10.1016/j.tacc.2020.06.008.
[36] N. Kumar, et al., Negative airflow isolation bed provides an option for NIV ventilation during COVID -19 pandemic, Trends Anaesth. Crit. Care 34 (2020) 59–60, https://doi.org/10.1016/j.tacc.2020.07.005.
[37] L.V. Duggan, S.D. Marshall, J. Scott, P.G. Brindley, H.P. Grocott, The MacGyver bias and attraction of homemade devices in healthcare, Can. J. Anaesth. 66 (2019) 757–761.
[38] W.B. Chekol, D.Y. Melesse, Operating room team safety and perioperative anesthetic management of patients with suspected or confirmed novel corona virus in resource limited settings: a systematic review, Trends Anaesth. Crit. Care 34 (2020) 14–22, https://doi.org/10.1016/j.tacc.2020.06.011.
[39] Jolin Wong, Shimin Ong, Lin Stella Ang, Intubation of the patient with a suspected or confirmed COVID-19 infection, TACC 33 (2020) 25–26.
[40] Achuthan Sajayan, Nitin Arora, Alastair Williamson, Ashok Nair, COVID intubation team (CIT)– an experience at a tertiary UK centre, TACC 33 (2020) 27–29.
[41] D. Convissar, L.E. Gibson, L. Berra, E.A. Bittner, M.G. Chang, Application of lung ultrasound during the COVID-19 pandemic: a narrative review, Anesth. Analg. (2020), https://doi.org/10.1213/ANE.0000000000004929.
[42] A. Anile, G. Castiglione, C. Zangara, C. Calabrò, M. Vaccaro, M. Sorbello, COVID: the new ultrasound alphabet in SARS-CoV-2 era, Anesth. Analg. (2020), https://doi.org/10.1213/ANE.0000000000005142.
[43] P. Dixit, et al., Ultrasound-guided central venous catheterization amid the COVID-19 outbreak: 'Revisiting protocols', Trends Anaesth. Crit. Care 34 (2020) 42–43, https://doi.org/10.1016/j.tacc.2020.06.009.
[44] W.J. Wiersinga, A. Rhodes, A.C. Cheng, S.J. Peacock, H.C. Prescott, Pathophysiology, transmission, diagnosis, and treatment of coronavirus disease 2019 (COVID-19): a review [published online ahead of print, 2020 jul 10], J. Am. Med. Assoc. (2020), https://doi.org/10.1001/jama.2020.12839.
[45] A.K. Azkur, M. Akdis, D. Azkur, et al., Immune response to SARS-CoV-2 and mechanisms of immunopathological changes in COVID-19, Allergy 75 (2020) 1564–1581, https://doi.org/10.1111/all.14364.
[46] D. Garg, A.K. Srivastava, R.K. Dhamija, Beyond fever, cough and dyspnea: the neurology of COVID-19, J. Assoc. Phys. India 68 (2020) 62–66.
[47] D. Kir, C. Mohan, R. Sancassani, HEART BRAKE-An unusual cardiac manifestation of Coronavirus disease 2019 (COVID-19), JACC Case Rep. 2 (9) (2020) 1252–1255, https://doi.org/10.1016/j.jaccas.2020.04.026.
[48] R. Gianotti, S. Recalcati, F. Fantini, et al., Histopathological study of a broad spectrum of skin dermatoses in patients affected or highly suspected of infection by COVID-19 in the northern part of Italy: analysis of the many faces of the viral-induced skin diseases in previous and new reported cases, Am. J. Dermatopathol. 42 (2020) 564–570, https://doi.org/10.1097/DAD.0000000000001707.
[49] P. Kaur, S. Posimreddy, B. Singh, et al., COVID-19 presenting as acute limb ischaemia, Eur. J. Case Rep. Intern. Med. 7 (2020), 001724, https://doi.org/10.12890/2020_001724.
[50] M.D. Leopard, M.T. Moorhouse, A case of Covid-19 associated laryngeal synechia as a cause for failed tracheostomy decannulation, Trends Anaesth. Crit. Care 34 (2020) 47–49, https://doi.org/10.1016/j.tacc.2020.07.008.
[51] M. Sorbello, K. El-Boghdadly, F. Petrini, Airway management in COVID-19: in the den of the beast, Anesth. Analg. (2020), https://doi.org/10.1213/ANE.0000000000004883.
[52] Y. Liu, L. Yan, L. Wan, T. Xiang, A. Le, J. Liu, et al., Viral dynamics in mild and severe cases of COVID-19, Lancet Infect. Dis. (2020), https://doi.org/10.1016/S1473-3099(20)30232-2, 2020.
[53] M. Sorbello, I. Hodzovic, G. Cusumano, G. Frova, Tracheal introducers and airway trauma COVID-19, Br. J. Anaesth. (2020), https://doi.org/10.1016/j.bja.2020.05.013. S0007-0912(20)30364-0.
[54] A. Wali, V. Rizzo, A. Bille, T. Routledge, A.J. Chambers, Pneumomediastinum following intubation in COVID-19 patients: a case series, Anaesthesia 75 (2020) 1076–1081.
[55] A. Borghesi, C. Aggiusti, D. Farina, R. Maroldi, M.L. Muiesan, COVID-19 pneumonia: three thoracic complications in the same patient, Diagnostics 10 (7) (2020) 498, https://doi.org/10.3390/diagnostics10070498.

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