

and for vastly less oxygen to be used.¹⁰ Furthermore, it will work with the patient in the prone position, and the cyclical movement of the bellows affords visual confirmation of adequate inspired volume. The ability to vary the degree of CPAP as shown in Fig 4b may well help with gaining feedback on the level of airway pressure at which breathing is easiest or 'most comfortable'.

It is important to note that the pressure-release valve must be reliable. If it were to fail, the pressure in the system would progressively increase. This increase in pressure would be relentless, the hand-ventilation reservoir bag would get larger, and the patient would be in trouble if the individual is too unwell to remove the mask. Thus patients being managed on the alternative system should not be left unattended, and care staff must understand why the sound of excess fresh gas flow venting from the bellows' pressure-release valve is not a leak but normal and necessary. Also, a comfortable face mask with an effective seal is important, and nasal CPAP masks seem unlikely to have a role as the weighted bellows would likely deflate when the patient spoke. The bellows unit is unavoidably heavy, with the weight acting on the bellows needing to be substantial and relevant to the cross-sectional area of the bellows on which it acts. Swings in the degree of CPAP with inspiration and expiration will occur, although these could be reduced with larger-diameter tubing between the bellows and the patient, and with bellows of a larger cross-sectional area, necessarily more heavily weighted. All considered, this alternative CPAP system may have a valuable role in the management of COVID-19 patients. It is versatile, does not require electricity, the expiratory gas can be 'scavenged to safe' in full, and it is not an 'aerosol-generator'.

Declarations of interest

The authors declare that they have no conflicts of interest.

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Safety considerations for neuraxial anaesthesia in parturients with COVID-19

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Keywords: ACE2; Caesarean section; COVID-19; dural puncture; neuraxial anaesthesia; neurological complications; SARS-CoV-2; spinal anaesthesia

Editor—Neurological symptoms have been reported in both severe and non-severe patients with coronavirus disease 2019 (COVID-19; 36.4%).¹ To decide the mode of anaesthesia for parturients with COVID-19, one should evaluate neurological symptoms in addition to respiratory symptoms. In recent clinical practice in Wuhan, China, neuraxial anaesthesia is the first and main choice in parturients with COVID-19 undergoing a Caesarean section.^{2–5} Other than the general benefits offered by neuraxial anaesthesia over general anaesthesia, an additional advantage of neuraxial anaesthesia for Caesarean delivery in parturients with COVID-19 is avoidance of airway manipulation and patient coughing during intubation and extubation, thus reducing the risk of aerosol generation and dispersion of viral particles. From January 1, 2020 to February 9, 2020, 36 Caesarean sections were performed uneventfully in Tongji Hospital, a university-affiliated general hospital in Wuhan with COVID-19 confirmed in 11 parturients (31%). In total, 31 parturients (86%) received neuraxial anaesthesia and five (14%) received general anaesthesia.⁶ Is neuraxial anaesthesia safe for COVID-19 patients? Should we reconsider neuraxial anaesthesia because of reported neurological symptoms in these patients?

Angiotensin-converting enzyme 2 (ACE2) is the functional receptor for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)⁷; it is expressed in the cell membrane of various tissues and organs including lung, small intestine, and brain.⁸ ACE2 in the brain might provide a mechanism for SARS-CoV-2 to cause neurological symptoms, but the possible invasion routes of SARS-CoV-2 remain unknown. Considering the invasion routes of other coronaviruses, SARS-CoV-2 might enter the CNS through the olfactory bulb, bloodstream, or peripheral nerve.⁹

The neurological symptoms of patients with COVID-19 can be divided into two categories: 1) CNS symptoms such as headache (13.1%), dizziness (16.8%), impaired consciousness (7.5%), ataxia (0.5%), acute cerebrovascular disease (2.8%), and epilepsy (0.5%)¹; and 2) peripheral nervous system symptoms, such as hyposmia (loss of smell) (5.1%), hypogeusia (loss of taste) (5.6%), hypopsia (visual deterioration) (1.4%), and neuralgia (2.3%).¹ It is difficult to distinguish between post-dural puncture headache and headache caused by SARS-CoV-2. It is also difficult to distinguish between neuralgia caused by mechanical injury during dural puncture and neuralgia caused by SARS-CoV-2. Spinal anaesthesia could carry the risk of introducing virus from blood or tissues into the CSF, which might lead to entry of the virus into the CNS, even though there is no direct evidence of this. When deciding on anaesthetic strategy for patients with COVID-19, we think that one should consider the possible deleterious effects on the nervous system by neuraxial anaesthesia. For patients with apparent central or peripheral nervous system symptoms, although direct evidence is still lacking, general anaesthesia

might be an acceptable alternative. However, general anaesthesia can impair the blood–brain barrier,¹⁰ which might facilitate the invasion of SARS-CoV-2 into the CNS. Additional studies are necessary to determine the best anaesthetic strategy for patients with COVID-19.

Declarations of interest

The authors declare that they have no conflicts of interest.

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