



Covid and Regional Anaesthesia

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Currently we are at the peak of the second wave of pandemic. Availability of beds & oxygen is at nadir. The patients coming to us for surgery are the ones where surgery cannot wait. Mainly the load is obstetric. As a matter of COVID pandemic policy we are using regional anaesthesia unless contraindicated or the surgery demands general anaesthesia. The aim is to avoid/reduce aerosolization which is part & parcel of GA, despite the efforts to minimise it. The policy is to protect the anaesthesiologists, surgeons, OT staff & other patients as well. The present manuscript is to review the role of regional anaesthesia & its safe performance.

Keywords: Surgery; anaesthesia; regional; aerosol.

1. INTRODUCTION

Anaesthesiologists by virtue of their position at head end come under high-risk groups of

healthcare providers. General anaesthesia involves airway interventions with aerosol generation [1,2,3]. The risk of infection to the anaesthesia provider is 6.6 times more [4]. In

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emergency & difficult airway scenarios the risk to the patient is also more from injury to failed intubation & post-operative pulmonary complications [5-10]. Lack of extended post-operative analgesia, associated nausea & vomiting, and the multiple drugs involved in balanced general anaesthesia having potential to interact with patient's medication which may include COVID medications are the drawbacks associated with GA. The American Society of Regional Anaesthesia (ASRA) [11], the European Society of Regional Anaesthesia and Pain Medicine (ESRA) and the European Society of Anaesthesiology (ESA) has published guidance on employing regional anaesthesia for patients with COVID-19. Our Indian counterpart AORA [12] (association of regional anaesthesia) has also come up with the statement.

The patient coming to us may be symptomatic or asymptomatic, rapid antigen negative or RTPCR (reverse transcriptase chain reaction) positive or negative, taking universal precautions is a must.

2. IS REGIONAL SAFE

The evidence suggests that regional anaesthesia including central neuraxial blockade can be safely administered in COVID patients & whatever the technique is chosen, it will not aggravate the COVID condition [13,14]. However, one must be watchful for hypotension which is likely to be an exaggerated response [15].

3. THE PATIENT STATUS

RTPCR – the gold standard – It detects nucleic acid of viral RNA. Sensitivity is 70%. So a negative test should not prelude standard protection protocol [16]. It can be supported by 2 negative RTPCR results in 48 hours & absence of suspected symptoms, or one negative test followed by negative HRCT 24 hr later [17]. This is practically impossible in most of the situations & patients are taken with a single RTPCR result. The lack of proper isolation facilities especially in peripheral settings & almost impossible task of testing the accompanying relatives of the patient further complicates the issue.

Rapid antigen- It only confirms a frank positive case in an emergency & negative does not rule out the disease.

The message is "Take universal precautions". Prevention is always better than cure.

4. THE POINTS TO BE NOTED DURING PAC

1. Look for clinical signs & symptoms of COVID, like fever, dry cough etc. [18].
2. Record testing status. [18].
3. Note any medication e.g., Hydroxychloroquine prolongs QT & has potential to develop ventricular arrhythmias. [18].
4. Careful assessment of cardiorespiratory status: note vitals carefully- temperature, pulse, respiration, haemoglobin saturation, & blood pressure [19].
 - A: These patients can suddenly land into respiratory failure, leading to sudden desaturation & CO₂ retention.
 - B: Haemodynamic instability & hypotension can occur suddenly in these patients as this virus is known to bind with angiotensin II converting receptors [20].
5. Carefully look for CNS & PNS signs & symptoms [21,22].

CNS- Headache, dizziness, history of convulsions & cerebrovascular episode. GA compromises blood brain barrier.

PNS- anosmia, hypogeusia, hyposmia and neuralgia.

 - A: Distinguishing post-Dural puncture headache and headache due to SARS-CoV-2 infection is difficult.
 - B: It can also be difficult to distinguish viral neuralgia from neuralgia caused by mechanical injury after a regional block.
 - C: SARS-CoV-2 virus can potentially be carried by the needle into the CNS -no direct evidence.
(in fact, GA can) [23]
6. Note the labs carefully. CBC, LFT, KFT, coagulation profile, biomarkers if indicated (D- dimer, IL6, serum ferritin, LDH, CRP, troponin I) [12,24,25]
 - A: Thrombocytopenia,
If lymphopenia- look for neutrophil/lymphocyte ratio (NLR), >3.3 in COVID-19 patients is a reliable indicator
 - B: Patients on anticoagulants
 - C: Liver (focus on LDH) & kidney function is compromised in some severe cases
7. Other investigations as per merit of the case like ECG, ECHO, Xray, HRCT etc.
8. Confirm availability of ICU beds for post-operative management [26].

In a retrospective study of 34 patients with confirmed disease, it was found that there was a mortality of 20.5%, and ICU bed required for 44.1% of patients.

5. WHAT IS CONCEIVED ABOUT REGIONAL ANAESTHESIA? [27]

1. A reduction in aerosol-generating procedures (AGPs) and thereby both increased safety and a saving in the time, resource, and financial costs of personal protective equipment (PPE).
2. Preservation of immune function when compared with general anaesthesia
3. Improved postoperative analgesia minimising direct contact with caregivers, and earlier discharge.
4. Avoiding a general anaesthetic in patients with active COVID-19 undergoing urgent surgery is likely to be beneficial, but there is also a suggestion that mortality rates of patients with undiagnosed COVID-19 who subsequently undergo surgery is higher.

These facts are well established backed up by evidence.

6. WHAT ARE THE AREAS OF CAUTION TO BE CONSIDERED?

- **Do we get more complacent with use of regional than with AGP generating procedures?**
- **Is quiet patient under well conducted GA with full protection is better than RA as there is no coughing, no vomiting?**

The disease spreads primarily via respiratory droplets and fomite transmission [28]. Droplets spread by gravity are up to <2 m. AGPs lead to more distant spread of the virus, & also remains airborne for a longer timer.

Coughing and sneezing are droplet-generating, but even talking and breathing also can generate aerosols. This must be remembered in an awake patient for whom droplet precautions alone would be used [29]. This is the most vulnerable group where a higher rate of infection has been found. [30].

PPE use is stratified into – 1. Contact ,2. droplet, and 3. airborne precautions. Current guidance in such elective cases with a low risk of conversion

to general anaesthesia remains to wear droplet precaution PPE only [31,32].

Other classifications of PPE are also suggested, for example: 1. droplet and contact; 2. airborne, droplet, and contact; 3. high-risk aerosol-generating medical procedures [33].

6.1 Simple Things Followed Strictly & Meticulously are Helpful: [34]

Limit the period of proximity between patient and healthcare worker while administering any regional.

Place a surgical mask on the patient.

Manipulation of oxygen therapy devices.

Limit/minimal sedation. (in view of possible low functional pulmonary reserve & subsequent complications)

Adopt airborne precautions in all.

6.2 Few Tips about Nasal/ Mask Oxygenation

Install nasal oxygen catheters under the surgical mask.

Remember high gas flows can increase aerosol dispersion. So, keep it minimal [35].

Hui et al. [36] showed that dispersion distance of exhaled air sideways increases with increase in oxygen flow (20 cm, 22 cm, 30 cm, and 40 cm in relation to the sagittal plane, using oxygen flows of 4 L.min⁻¹, 6 L.min⁻¹, 8 L.min⁻¹ and 10 L.min⁻¹ respectively).

Cough can also increase dispersion to even longer distances.

Face masks for supplementary oxygen administration replace nasal catheters efficiently and are preferable.

Surgical masks over face masks reduce aerosol dispersion.

Fresh gas flow administered to the patient should be as low as possible to maintain oxygen within normal parameters.

Prophylactic administration of an anti-emetic drug is preferred to reduce the risk of vomiting and viral spread [12]

6.3 Caution with SAB

The SARS-CoV-2 virus has been isolated in the CSF; for this reason, avoid dripping during spinal anaesthesia [37]

COVID-19 carriers, as already mentioned previously, can present hemodynamic instability, mainly after neuraxial blocks, and intense hypotension can occur [38,39]. Vasopressor may be required.

To date there are no specific recommendations as to management of post-puncture headache in patients with COVID-19.

The sphenopalatine lymph node block should not be performed routinely because it can produce aerosols, increasing the risk of transmission of SARS-CoV-2 to health professionals.

The epidural blood patch should be considered carefully in view of the possibility of the virus in the CSF. There is the possibility of a significant introduction of viral load, with possible neurological complications [40] If required, it should be postponed to after recovery from infection.

6.4 Surgery on Upper Limb: [12]

Select a surgically congruent technique with least interference of respiratory function.

USG guidance is better than PNS to ensure success, even a combined technique, to avoid unanticipated GA.

Use sterile plastic drapes over the patient.

Ensure successful block/optimal operating conditions before the knife is on.

Can consider rescue blocks.

Brachial plexus block should be performed by the most experienced person. If in doubt, even experts should take into consideration the best possible USG image [41].

6.5 In patients with Demonstrable Saturation of Less than 95%, Options for Proximal Humerus Surgery:

1. Ultrasound-guided superior trunk block (12-15 ml)
2. Administer an ultrasound guided incremental interscalene brachial plexus block (ISB) through a catheter at C5-6, followed by a graded increase in LA volume in an aliquot of 3 ml at each time. This should be done under continuous monitoring of saturation and diaphragmatic excursions
3. Supraclavicular block: With ultrasound-guided LA volume should not exceed more than 20 ml. However, with neurostimulation guided block the volume should not exceed more than 25 ml.

7. OBSTETRIC ANAESTHESIA [12]

- Pregnant patients from the containment zone will undergo RT-PCR test as per ICMR guidelines
- Consider neuraxial block as it minimizes the need for general anaesthesia in case of emergency caesarean section.
- As the incidence of hypotension is likely to be higher, anaesthesiologist must be aware of the same.
- The lower limit of platelet count for performing neuraxial procedures is $70,000 \times 10^6/L$, to avoid spinal/epidural hematoma. However, respiratory compromise with general anaesthesia is much higher and hence neuraxial procedures at even lower platelet counts should be considered [42]
- Though the risk of epidural or subarachnoid space seeding with viraemic blood, causing encephalitis or meningitis, is exceedingly rare, it remains a theoretical possibility [43,44]
- Currently, there is no evidence to suggest vertical transmission, although transmission after birth due to contact with infectious respiratory secretions is possible [39]. It is advisable to separate the mother from the baby while diagnostic testing is being performed. Involve paediatricians early for caring for neonates born to COVID-19 mothers [45].
- A recent report of a neonate born to a COVID-19 infected mother shows a possibility of in-utero infection [45].

- Meanwhile, ensure maximal level PPE (gown, gloves, facemask, and eye protection) for feeding and care
- It is suggested, the elevated immunoglobulinM (IgM) are not transferred to the foetus via the placenta, during the 23 days between maternal infection and delivery [46-49]

7.1 Paediatric Regional Anaesthesia

- The scope and play of regional anaesthesia is same as adults
- Consider a good premedication unless contraindicated [50]. This will minimize the agitation and crying & contribution to more aerosolization
- The face mask is not indicated in neonates and children in less than 2 years for the possibility of suffocation
- The accepted practise to giving concomitant general anaesthesia shall hold sway for obvious reasons. Certainly, general anaesthesia with intubation and closed circuits with
- appropriately sized filters would be preferred over face masks or LMA to minimize aerosol generation.
- Practices of continuous epidural catheters and perineural catheters should be encouraged because of their opioid-sparing effects.

7.2 Continuous Catheters: [12]

- The decision on perineural catheters should be made on the invasiveness of the surgery [15]
- Continuous catheter techniques are beneficial but require frequent follow-up with the patient, however, the benefit of opioid sparing effect in patients with respiratory morbidity cannot be overlooked [34].
- Further, postoperative catheter management in COVID-19 patient includes frequent handling of the infusion pump, laboratory investigations, neurological examinations, and the need for maximal level PPE
- The catheters used should be discarded in a biohazard bag and sealed.

8. THE SAME LOGIC APPLIES TO SPINAL & EPIDURAL CATHETERS

8.1 Local Anaesthetic Systemic Toxicity (LAST): [12]

- A safe dose of local aesthetic (LA) should be calculated and used; the blocks should be performed with ultrasound guidance to reduce the risk of local anaesthetic systemic toxicity (LAST) [5,6]
- In the case of LAST, additional personnel called for help should be protected with maximal level PPE before resuscitation [5,6]
- Follow the current guidelines for the management of LAST [5,6]
- Identify one person responsible to adequately restock the drugs and equipment if and when required [11,20,21]

We follow AORA Academy of Regional anaesthesia of India, published clinical guidelines for performance of regionals.

The various associations' recommendations, ASRA, ESRA, AORA, taken into consideration in nutshell convey the same message

8.2 To Conclude: [18]

8.2.1 Safe practice is the best approach

Wear appropriate protection considering all possibilities.

Surgical mask to all patients.

Protect equipment like USG probe, machines with plastic covers.

Minimal personnel minimal drugs & equipment in the operation theatre.

Keep backup in ante room.

8.2.2 Appropriate technique appropriate experienced Anaesthesiologist

Prepare required drugs and put them in a dedicated plastic bag.

Use a block which will impact respiration least e.g., axillary block or infra-clavicular brachial plexus block.

Weigh Risks and benefits before using adjuvants and continuous perineural catheters.

Check for/ rule out thrombocytopenia before neuraxial anaesthesia.

Currently, there is no recommendation to adjust the doses of regional anaesthesia techniques.

Be alert and ready for hypotension after neuraxial anaesthesia.

Use US-guided peripheral nerve blocks.

Whenever possible, postpone epidural blood patch until recovery from acute infection.

8.2.3 No replacement to vigilance

After use, the US device must be disinfected.

Test the effect carefully before the knife is on to avoid conversion to GA

Patient post-anaesthesia recovery should be performed on the same site where the procedure was performed.

Use the lowest oxygen supplement flow required to keep O2 saturation.

Be ready for possible block failure and local anaesthetic systemic toxic reactions

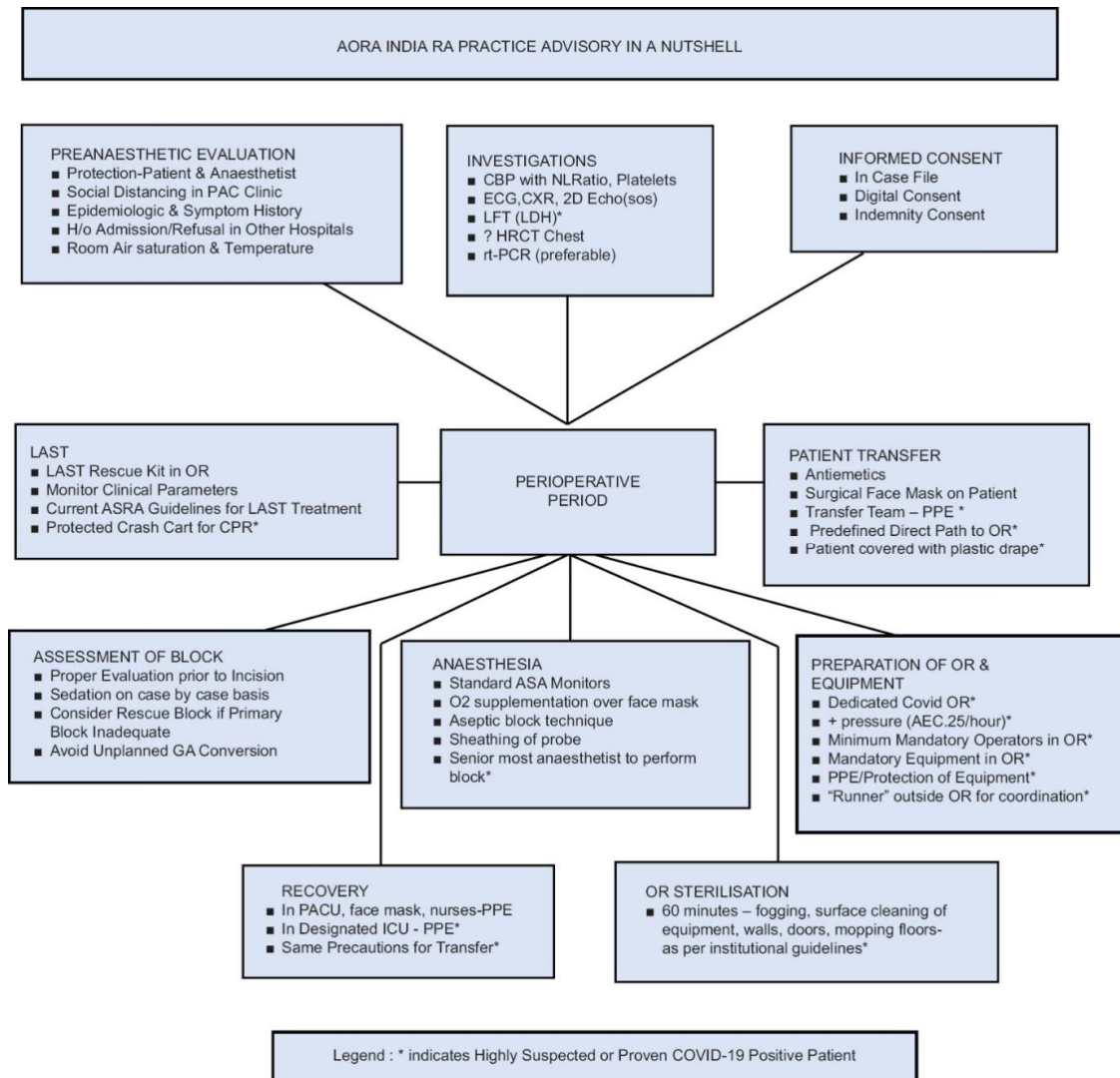


Fig. 1. Practice advisory in a nut shell

9. CONCLUSION

The study discusses the policies to avoid/reduce aerosolization which is part & parcel of GA, despite the efforts to minimise it. The policy is to protect the anaesthesiologists, surgeons, OT staff & other patients as well.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. World Health Organization. Infection prevention and control of epidemic and pandemic-prone acute respiratory diseases in health care. Geneva: WHO; 2014.
2. Tran K, Cimon K, Severn M, et al. Aerosol generating procedures and risk of transmission of acute respiratory infections to healthcare workers: a systematic review. *PLoS One*. 2012;7:e35797.
3. Orser BA. Recommendations for endotracheal intubation of COVID-19 patients. *Anesth Analg*. 2020;130:1109-10.
4. COVID-19 guidance for regional anesthesia neuraxial anesthesia and peripheral nerve blocks. Available: <https://esraeurope.org/wp-content/uploads/2020/04/ESRAASRA-COVID-19-Guidelines-.pdf>. [Access 21 April 2020].
5. Daniel V, Daniel K. Perception of Nurses' Work in Psychiatric Clinic. *Clinical Medicine Insights*. 2020;1(1):27-33. DOI: <https://doi.org/10.52845/CMI/2020v1i1a5>
6. Zeng H, Xu C, Fan J, Tang Y, Deng Q, Zhang W, et al. Antibodies in infants born to mothers with COVID-19 pneumonia. *JAMA*. 2020;323:1848-9.
7. Daniel V, Daniel K. Exercises training program: Its Effect on Muscle strength and Activity of daily living among elderly people. *Nursing and Midwifery*. 2020;1(01):19-23. DOI: <https://doi.org/10.52845/NM/2020v1i1a5>
8. Lee-Archer P, von Ungern-Sternberg BS. Paediatric aesthetic implications of COVID-19—A review of current literature. *Pediatr Anesth*; 2020. DOI: 10.1111/pan.13889
9. Association of Anaesthetists. Management of severe local anaesthetic toxicity. Available from: DOI: <https://doi.org/10.21466/g.MOSLAT2.2010>. [Last accessed on 2020 Mar 21].
10. El-Boghdadly K, Pawa A, Chin KJ. Local anesthetic systemic toxicity: Current perspectives. *Local Reg Anesth*. 2018;11:35-44.
11. Practice recommendations on neuraxial anesthesia and peripheral nerve blocks during the COVID-19 Pandemic. Available: <https://www.asra.com/page/2905/practice-recommendations-on-neuraxial-anesthesia-and-peripheral-nerve-blocks-dur>. [Access 21 April 2020].
12. Regional anesthesia in the coronavirus disease (COVID-19) pandemic: Clinical guidelines by AORA, India Ponde VC, et al. *Regional anesthesia in COVID-19 pandemic Journal of Anaesthesiology Clinical Pharmacology*. 2020;36(Supplement 1).
13. Zhong Q, Lui YY, Zou YF, et al. Spinal anaesthesia for patients with coronavirus disease 2019 and possible transmission rates in anaesthetists: retrospective, single center, observational cohort study. *Brit J Anaesthesia*. 2020;124:670-5. DOI: <http://dx.doi.org/10.1016/j.bja.2020.03.007>.
14. Yue L, Han L, Li Q, et al. Anaesthesia and infection control in cesarean section of pregnant women with coronavirus disease 2019 (COVID-19). *medRxiv*. 2020; 03:20040394. DOI: <http://dx.doi.org/10.1101/2020.03.23.20040394>.
15. Chen R, Zhang Y, Huang L, et al. Safety and efficacy of different anesthetic regimens for parturients with COVID-19 undergoing cesarean delivery: a case series of 17 patients. *Can J Anaesth*. 2020;2020, <http://dx.doi.org/10.1007/s12630-020-01630-7>.
16. Watson J, Whiting PF, Brush JE. Interpreting a COVID-19 test result. *BMJ* 2020;369:m1808. Available: <https://www.escardio.org/Education/COVID-19%20and%20Cardiology/ESC%20COVID-19%20Guidance>. [Last accessed on 2020 Jun 06].
18. Lima RM, et al. Regional anesthesia at times of COVID-19: *Rev Bras Anesthesiol*. 2020;70(2):159-164.

19. Thomas-Rüddel D, Winning J, Dickmann P, et al. Coronavirus disease 2019 (COVID-19): update for anesthesiologists and intensivists March 2020. *Anaesthesist*. DOI:https://doi.org/10.1007/s00101-020-00760-3
20. Buran T, Sanem Gökçe Merve Kılınc, Elmas Kasap. Prevalence of extraintestinal manifestations of ulcerative colitis patients in Turkey: Community-based monocentric observational study. *Clinical Medicine and Medical Research*. 2020;1(2):39-46. DOI:https://doi.org/10.52845/CMMR/2020v1i2a8
21. Mao L, Jin H, Wang M, et al. Neurologic manifestations of hospitalized patients with coronavirus disease 2019 in Wuhan, China. *JAMA Neurol*; 2020. DOI:http://dx.doi.org/10.1001/jamaneurol.2020.1127 (online ahead of print)
22. Sun X, Liu Y, Mei W. Safety considerations for neuraxial anaesthesia in parturients with COVID-19. *Br J Anaesth*; 2020. DOI:http://dx.doi.org/10.1016/j.bja.2020.05.005 (online ahead of print).
23. Yang S, Gu C, Mandeville ET, et al. Anesthesia and surgery impair blood-brain barrier and cognitive function in mice. *Front Immunol*. 2017;8:902.
24. Lippi G, Plebani M, Henry BM. Thrombocytopenia is associated with severe coronavirus disease 2019 (COVID-19) infections: a meta-analysis. *Clin Chim Acta*. 2020;13:145--8. DOI:http://dx.doi.org/10.1016/j.cca.2020.03.022.
25. Narouze S, Benzon HT, Provenzano D, et al. Interventional spine and pain procedures in patients on antiplatelet and anticoagulant medications (Second Edition): guidelines from the American Society of Regional Anesthesia and Pain Medicine, the European Society of Regional Anesthesia and Pain Therapy, the American Academy of Pain Medicine, the International Neuromodulation Society, the North American Neuromodulation Society, and the World Institute of Pain. *Reg Anesth Pain Med*. 2018;43:225--62.
26. Lei S, Jiang F, Su W, et al. Clinical characteristics and outcomes of patients undergoing surgeries during the incubation period of COVID-19 infection. *E Clin Med*. 2020;100331. DOI:http://dx.doi.org/10.1016/j.eclinm.2020.100331.22
27. Regional anaesthesia and COVID-19: first choice at last? Alan J. R. Macfarlane, William Harrop-Griffiths^{3,4} and Amit Pawa⁵ *British Journal of Anaesthesia*. 2020;125(3):243e247. DOI: 10.1016/j.bja.2020.05.029 Advance Access Publication Date: 28 May 2020 © 2020 British Journal of Anaesthesia. Published by Elsevier Ltd. All rights reserved.
28. Public Health England Transmission characteristics and principles of infection prevention and control. Available:https://www.gov.uk/government/publications/wuhan-novel-coronavirus-infection-prevention-and-control/transmission-characteristics-and-principles-of-infection-prevention-and-control
29. Lewis D. Is the coronavirus airborne? Experts can't agree. *Nature*. 2020;580:175. [PubMed] [Google Scholar]
30. Zhong Q, Liu YY, Luo Q, et al. Spinal anaesthesia in patients with coronavirus disease 2019 and possible transmission rates in anaesthetists: retrospective, single centre, observational cohort study. *Br J Anaesth*, Advance access March 28; 2020. DOI:doi.org/10.1016/j.bja.2020.03.007 [PMC free article] [PubMed]
31. Cook T, Harrop-Griffiths W. Personal protective equipment (PPE) for COVID-19 positive or possible patients. Available:https://static1.squarespace.com/static/5e6613a1dc75b87df82b78e1/t/5e91ee25a89a10132534a96e/1586621990439/PPE-guidance2020_11.04.20.pdf
32. Bampoe S, Odor PM, Lucas DN. Novel coronavirus SARS-CoV-2 and COVID-19. Practice recommendations for obstetric anaesthesia: what we have learned thus far. *Int J Obs Anesth*, Advance access April 23; 2020. DOI:doi.org/10.1016/j.ijoa.2020.04.006 [PMC free article] [PubMed]
33. Lockhart SL, Duggan LV, Wax RS, et al. Personal protective equipment (PPE) for both anesthesiologists and other airway managers: principles and practice during the COVID-19 pandemic. *Can J Anesth* Advance access April 23; 2020. DOI:doi.org/10.1007/s12630-020-01673-w [PMC free article] [PubMed]

34. Uppal V, Sondekoppam RV, Landau R, El-Boghdady K, Narouze S, Kalagara HKP. Neuraxial anaesthesia and peripheral nerve blocks during the COVID-19 pandemic: a literature review and practice recommendations. *Anaesthesia*, Advance access published on April 28; 2020. DOI:10.1111/anae.15105 [PMC free article] [PubMed]
35. Simonds AK, Hanak A, Chatwin M, et al. Evaluation of droplet dispersion during non-invasive ventilation, oxygen therapy, nebuliser treatment and chest physiotherapy in clinical practice: implications for management of pandemic influenza and other airborne infections. *Health Technol Assess*. 2010;14:131-72.
36. Hui DS, Hall SD, Tang JW, et al. Exhaled air dispersion during oxy-gen delivery via simple oxygen mask. *Chest*. 2007;132:540-6.
37. Filatov A, Sharma P, Hindi F, et al. Neurological complications of coronavirus disease (Covid-19): encephalopathy. *Cureus*. 2020;12:e7352. DOI:<http://dx.doi.org/10.7759/cureus.7352>
38. Wong J, Goh QY, Tan Z, et al. Preparing for a covid-19 pandemic: a review of operating room outbreak response measures in a large tertiary hospital in Singapore. *Can J Anaesth*. 2020;67(6):732-45.
39. Uppal V, McKean DM. Strategies for prevention of spinal-associated hypotension during cesarean delivery: are we paying attention? *Can J Anaesth*. 2017;64:991-6. DOI:<http://dx.doi.org/10.1007/s12630-017-0930-0>
40. Webb CA, Weyker PD, Zhang L, et al. Unintentional dural puncture with a Tuohy needle increases risk of chronic headache. *Anesth Analg*. 2012;115:124-32.
41. Lie SA, Wong SW, Wong LT, Wong TGL, Chong SY. Practical considerations for performing regional anesthesia: Lessons learned from the COVID-19 pandemic. *Can J Anaesth* 2020;67:885-92.
42. Bauer ME, Bernstein K, Dinges E, Delgado C, El-Sharawi N, Sultan P, et al. Obstetric Anesthesia during the COVID-19 pandemic. *Anesth Analg*. 2020;131:7-15
43. Chen R, Zhang Y, Huang L, Cheng BH, Xia ZY, Meng QT. Safety and efficacy of different anesthetic regimens for parturients with COVID-19 undergoing Cesarean delivery: A case series of 17 patients. *Can J Anaesth*. 2020;67:655-63.
44. Miller AJ, Arnold AC. The renin-angiotensin system in cardio-vascular autonomic control: recent developments and clinical implications. *Clin Auton Res*. 2019;29:231-43.
45. Song L, Xiao W, Ling K, Yao S, Chen X. Anesthetic management for emergent cesarean delivery in a parturient with recent diagnosis of coronavirus disease 2019 (COVID-19): A Case Report. *Transl Perioper Pain Med* 2020;7:234-7.
46. Breslin N, Baptiste C, Miller R, Fuchs K, Goffman D, Gyamfi-Bannerman C, et al. Coronavirus disease 2019 in pregnancy: Early lessons. *Am J Obstet Gynecol MFM* 2020;2:100111.
47. Xia H, Zhao S, Wu Z, Luo H, Zhou C, Chen X. Emergency caesarean delivery in a patient with confirmed COVID-19 under spinal anaesthesia. *Br J Anaesth* 2020;124:e216-18.
48. Daniel V, Daniel K. Diabetic neuropathy: new perspectives on early diagnosis and treatments. *Journal of Current Diabetes Reports*. 2020;1(1):12-14. DOI:<https://doi.org/10.52845/JCDR/2020v1i1a3>
49. Zhong Q, Liu YY, Luo Q, Zou YF, Jiang HX, Li H, et al. Spinal anaesthesia for patients with coronavirus disease 2019 and possible transmission rates in anaesthetists: Retrospective, single-centre, observational cohort study. *Br J Anaesth*. 2020;124:670-5.
50. Dong L, Tian J, He S, Zhu C, Wang J, Liu C, Yang J. Possible vertical transmission of SARS-CoV-2 from an infected mother to her new born. *JAMA* 2020;323:1846-8.

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