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.

(hypercarbia, tachycardia, raised temperature, hypoxaemia, acidosis, hyperkalaemia[4]), such as sepsis, respiratory failure, or acute kidney injury: these clinical features are also frequently observed in critically ill patients with COVID-19.[5] Also adequate stocks of dantrolene[6] and activated charcoal filters[7] should be available.

Population genome and exome sequencing projects have revealed the high population incidence (1:1500) of genetic variants associated with susceptibility to MH.[8] It is likely that there are genetic and non-genetic factors contributing to the discrepancy between the prevalence of such genetic variants and the incidence of clinical MH,[9] but these are unknown. It is possible that the non-genetic contributors to triggering may be more common in critically ill patients, so although the current low incidence of MH in the ICU setting is likely to reflect the infrequent use of volatile anaesthetic sedation, an increase in this practice may reveal that critically ill MH susceptible patients have a greater chance of triggering than in the operating theatre.

As volatile anaesthetic sedation becomes more prevalent, intensivists and ICU nurses should be added to anaesthetists, pre-hospital practitioners, and emergency room physicians in the list of practitioners who need to be explicitly aware that MH reactions still occur, and can be triggered by use of any of the volatile anaesthetic agents, including methoxyflurane,[10] and by the depolarising neuromuscular blocking agent succinylcholine.[4]

Funding

VK was funded by a Medical Research Council (UK)/British Journal of Anaesthesia Clinical Research Training Fellowship Grant (MR/N002407/1).

Declarations of interest

PMH is an editorial board member of the *British Journal of Anaesthesia*.

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doi: 10.1016/j.bja.2020.09.012
Advance Access Publication Date: 16 September 2020

Neuraxial anaesthesia in the context of bacterial meningitis and COVID-19

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Keywords: COVID-19; meningitis; neuraxial anaesthesia; regional anaesthesia; SARS-CoV-2; spinal anaesthesia

Editor—Recommendations to limit airway instrumentation and mechanical ventilation in coronavirus disease 2019 (COVID-19) patients suggest an expanded role for regional anaesthesia.[1,2] The complex considerations stemming from the COVID-19

pandemic justify reconsideration of contraindications to regional anaesthesia in certain patients.[2] We describe use of spinal anaesthesia in a COVID-19 patient with bacteraemia, epidural infection, and bacterial meningitis. The patient provided written consent for publication of this case report.

A 64-yr-old male with history of smoking, obesity (body mass index 38 kg m^{-2}), and bilateral total knee arthroplasties presented with left knee pain, fever, cough, lumbar radiculopathy, and urinary retention. He was haemodynamically stable with a temperature of 38.9°C, tachycardia, tachypnoea and SpO_2 95% on room air. Physical exam showed a hot swollen left knee.

Nasopharyngeal swab testing was positive for severe acute respiratory syndrome-related coronavirus-2 (SARS-CoV-2), and laboratory studies showed leucocyte count 13.9×10^9 L^{-1}, platelet count 255×10^9 L^{-1}, and high sensitivity C-reactive protein >300 mg L^{-1}. Knee aspiration yielded 110 ml of fluid with 3+ Gram-positive cocci in pairs. Joint aspirate and blood cultures grew methicillin-susceptible *Staphylococcus aureus* (MSSA) and i.v. vancomycin was initiated. Chest radiography was unremarkable. MRI showed diffuse conus pial and cauda equina enhancement with an epidural collection centred at the T12–T1 level tracking superiorly. This was managed non-surgically. Lumbar puncture by the neurologist yielded 16 ml of turbid, free-flowing CSF with 1+ Gram-positive cocci in pairs, and culture grew MSSA. After patient-inclusive discussion of anaesthetic options, left knee arthrotomy, drainage, and liner exchange under spinal anaesthesia was planned. The patient demonstrated an understanding of the risks and benefits, endorsed a preference for neuraxial anaesthesia, and gave informed consent.

In the operating room, levofloxacin i.v. was administered as additional antimicrobial prophylaxis. A 17G Tuohy needle was sterilely introduced at the L3–4 interspace. Flow of straw-coloured CSF was obtained at a depth of 9 cm and a multiport catheter was threaded to 14 cm to facilitate titration of local anaesthetic. Mepivacaine 1.5%, 5 ml was incrementally injected, titrated to resolution of pain and complete sensorimotor block of the lower extremities, resulting in a T8 sensory level. He remained haemodynamically stable. The 90-min surgery was uncomplicated with minimal blood loss. The patient wore a surgical mask and received oxygen 2 L min^{-1} via a nasal cannula to maintain SpO_2>92%. The spinal catheter was removed at the end of the procedure. Postoperatively, he experienced no post-dural puncture headache or other complications.

Neuraxial anaesthesia is contraindicated in patients with bacteraemia, epidural abscess, or meningitis.[3] Neuraxial anaesthesia in infected patients should not be considered routine, but this case demonstrates a justifiable exception based on analysis of risks and benefits and competing interests. As noted in a recent editorial, 'It is reasonable to consider administering regional anaesthesia to patients at higher risk of complications simply to avoid general anaesthesia during the pandemic.'[2]

In COVID-19, concerns surrounding general anaesthesia include risks to staff (viral transmission) and to the patient (precipitating respiratory failure).[4–6] Patient safety was our paramount concern. History of obesity, smoking, and viral respiratory infection increased this patient's risk for pulmonary complications. Moreover, deleterious effects of general anaesthesia and mechanical ventilation could be exacerbated in the setting of COVID-19 given its unpredictable and potentially lethal course.[5,6]

Concerns regarding neuraxial anaesthesia were considered. Because the blood, epidural space, and CSF were already infected, additional harm from repeat dural puncture was thought to be justifiably low. Intrathecal and meningeal inflammation raised theoretical uncertainties regarding efficacy and duration of spinal anaesthesia.[7] We administered mepivacaine because of its low pKa and threaded an intrathecal catheter to facilitate titration to effect. Preparations were made to convert to general anaesthesia and secure the airway if necessary.[8]

Alternative regional anaesthesia techniques were discussed with the surgical team and the patient. Peripheral nerve blocks were deemed inferior because of (1) challenges with positioning and ultrasound visualisation related to the patient's obesity and inability to tolerate lower extremity manipulation, (2) need for multiple blocks requiring nearly maximal doses of local anaesthetic, (3) slower onset, and (4) less predictable extent of sensory and motor blockade deemed essential by the surgical team. Efficacy of epidural, combined spinal–epidural, or single-shot spinal anaesthesia was considered unpredictable because of epidural and intrathecal infection. Given these variables, intrathecal titration of local anaesthetic appeared to optimise chances of success.

Declarations of interest

The authors declare that they have no conflicts of interest.

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doi: 10.1016/j.bja.2020.09.008
Advance Access Publication Date: 9 September 2020